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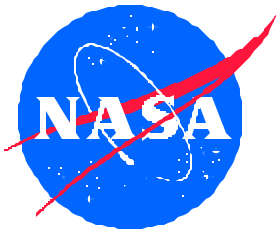
Performance Assurance Requirements (PAR) for the

November 1996



GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

GSFC-S-480-89
NOVEMBER 11, 1996

PERFORMANCE ASSURANCE REQUIREMENTS

FOR THE

SOLID STATE RECORDERS

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PERFORMANCE ASSURANCE REQUIREMENTS FOR THE SOLID STATE RECORDER

1. GENERAL REQUIREMENTS

1.1 BASIS AND SCOPE OF THE REQUIREMENTS

This document incorporates the applicable portions of the National Aeronautics and Space Administration (NASA) Reliability and Quality Assurance handbook NHB 5300.4(1A) and (lB) and, in addition, contain other element of performance assurance such as reviews, safety, functional and environmental testing, and contamination control.

1.2 GENERAL REQUIREMENTS

The contractor shall establish an organized program for demonstrating that the design meets the functional requirements, including specified margins, that the hardware has been manufactured properly and will operate properly in association with all other project components, and that the software meet design and mission requirements.

The contractor shall implement and maintain a performance assurance program that encompass flight equipment, Government-furnished property, and spares. The program applies to all work accomplished by the contractor and the subcontractors and suppliers (also termed "contractor”) who provide software, flight hardware, and support.

1.3 MANAGEMENT OF THE ASSURANCE PROGRAM

The contractor shall implement a system for effective management control and audit of the assurance program. He shall assign responsibility and authority for managing the assurance activities to individuals who have unimpeded access to higher management.

1.4 PERFORMANCE ASSURANCE STATUS REPORT

A Performance Assurance Status Report shall be prepared and submitted as part of the monthly status report. It shall contain the status of the assurance activities, any deficiencies that could affect the end-item product, and the intended corrective action. The report shall cover the following items, as well as those called for in the individual sections of this document:

a. Significant assurance problems

b. Key organization and personnel changes

c. Significant inspection and test activities

d. Status of procurements and subcontractor performance assurance programs (with problem areas flagged as early as possible)

1.5 SURVEILLANCE OF THE CONTRACTOR

The work, activities, and operations of the contractor, subcontractors, and suppliers shall be subject to evaluation, review, survey, and inspection by Government-designated representatives from the GSFC project office, and the Government Inspection Agency GIA). GSFC will delegate comprehensive and specific in-plant responsibilities and authority to these agencies in a letter of delegation.

The contractor shall provide the government representative with the documents, records, equipment, and working areas within his facilities that the government representative requires for performing his activities.

Where contractor source inspection is used, the contractor shall provide a list of duties, reponsibilities, and authorities of his quality assurance (QA) personnel to the designated Government quality representative. When Government source inspection personnel are used at any supplier's facility, the listing shall also be provided to the Government source representative at that facility upon issuance of the procurement.

1.6 GENERAL PROCUREMENT REQUIREMENTS

1.6.1 Selection of Sources

When the contractor selects procurement sources, he shall assign assurance personnel to participate in the selection. Performance history, receiving inspection and test result, supplier rating system, and survey results shall be used to assess the capability of each potential procurement.

1.6.2 Requirement on Subcontractor and Suppliers

The contractor shall ensure that his procurement document imposes the applicable requirement of this document on subcontractors and suppliers. The subcontractor and suppliers shall in turn impose the requirements on their procurement sources.

1.7 AUDITS

The contractors shall conduct audits of his assurance activities and those of his subcontractors and suppliers to ensure compliance with appropriate provisions of this document. To verify the effectiveness of the performance assurance systems, each audit shall include an examination of operations and documents, as well as an examination of materials.

1.7.1 Subcontractor and Supplier Audits

The contractor shall perform audits of his subcontractors and suppliers as necessary to ensure compliance with the subcontractor performance assurance requirements. The contractor's schedule and conduct of the audits shall be based upon the following:

a. Criticality of items being procured, those items identified by failure mode, effects, and criticality analyses, of information from trend analyses

b. Known problems or difficulties

c. Supplier quality history

d. Remaining period of supplier performance

1.7.2 Audit Reports

A documented account of audits shall be submitted to the contractor's management with recommendations for correcting any deficiencies. Management shall take action to ensure correction of any deficiencies and shall conduct appropriate review to ensure that the correction have been made.

Audit reports shall be made available to the government representative on request, and a summary of the audit reports shall be submitted to GSFC as part of the Performance Assurance Status Report (paragraph 1.5).

1.8 APPLICABLE DOCUMENTS (APPENDIX A)

To the extent referenced herein, applicable portions of the documents and revision levels listed in Appendix A form a part of this document.

1.9 GLOSSARY (APPENDIX B)

Appendix B lists definitions that are needed for a common understanding of terms are applied in this document.

2. ASSURANCE REVIEW REQUIREMENTS

2.1 GENERAL REQUIREMENTS

The contractor shall for new or modified elements of the program conduct a program of planned, scheduled, and documented reviews covering the flight hardware, flight software, ground support equipment, software, operations ground equipment, and ground data processing for which the contractor has responsibility. The contractor's program shall include reviews at the component and subsystem level as required by paragraph 2.5, and include support to reviews conducted by a POES Flight Assurance Review Team.

2.2 POES FLIGHT ASSURANCE REVIEW REQUIREMENTS

The contractor shall support a series of comprehensive design reviews that are conducted by a POES Flight Assurance Review Team. For each specified review, the contractor shall:

a. Develop and organize material for oral presentation to the POES review team. Copies of visual aids and other supporting material that are pertinent to the review shall be submitted in accordance with Appendix C.

b. Support splinter review meetings that result from the major reviews.

c. Produce written responses to recommendations and action items that result from the reviews.

2.3 POES FLIGHT ASSURANCE REVIEW PROGRAM

The Flight Assurance Review Program shall consist of individual reviews as described in paragraphs 2.3a through c.

a. Critical Design Review (CDR)--For new or modified elements of the program, this review usually occurs after the design has been frozen but prior to the start of manufacture of flight components. It will emphasize implementations of design as well as test plans for flight systems including the results of engineering model testing.

b. Preliminary Design Review (PDR)--This review shall be conducted at the conclusion of the detailed design efforts and after testing the breadboard models of critical designs. Topics to be reviewed will include designs, analyses, calibration techniques, and recorder certification test plans.

c. Pre-environmental Review (PER)--This review occurs prior to the start of environmental testing on each flight system. The primary purpose of this review is to establish the readiness of the system for test and evaluate the environmental test plans.

d. Pre-shipment Review (PSR)--This review will take place prior to shipment of the flight instrument to the spacecraft contractor and will concentrate on system performance during acceptance testing.

NOTE: Delivery of flight model instruments to the spacecraft contractor shall not take place until after the resolution of all action items resulting from the respective PSRs unless otherwise directed in writing by GSFC.

2.4 CONTRACTOR INTERNAL REVIEW REQUIREMENTS

The internal review program shall consist of design reviews at each box and subassembly level and at lower levels of assembly when required for new or changed boxes. As part of the design reviews, packaging reviews shall be considered for all new electrical, electronic, and electromechanical (EEG) components in the flight system. Each packaging review shall evaluate the ability of the packaging concept and design to perform successfully during testing and under operating and environmental conditions of the mission. These reviews shall be conducted in accordance with GSFC S-311-98A, “Guidelines for Conducting a Packaging Review”(minus para. 3.0 “Submittal and Notification” is not required”, see Appendix A). In addition to these packaging guidelines, the reviews shall specifically address the following:

a. Placement, mounting, and interconnection of each EEE part or circuit board or substrate,

b. Structural support and thermal accommodation of the boards and substrates and their interconnections in the component design,

c. Provisions for protection of the parts and ease of inspection.

Component level design reviews shall include of the pertinent parts stress analyses required by paragraph 7.3.2 and of the corresponding component packaging reviews including the results of associated tests and analyses.

Contractor personnel who are not directly responsible for hardware design shall conduct these reviews. Review data packages shall be made available at CDR. The results of the reviews shall be documented, and a summary of each review shall be included in the Performance Assurance Status Report (paragraph 1.6).

3. Performance Verification Requirements

3.1 GENERAL REQUIREMENTS

A Performance Verification Program shall be conducted to ensure that the recorder changes meet the specified mission requirements. The program consists of a series of functional demonstrations, analytical investigations, physical property measurements, and environmental tests that simulate the environments encountered during prelaunch, launch, and in-orbit flight. All protoflight hardware shall undergo qualification tests to demonstrate compliance with the verification requirements of this section. Environmental testing shall be in accordance with Appendix D of this document.

The Performance Verification Program begins with functional testing of assemblies, continues through the functional and environmental testing at the component, recorder and spacecraft levels of assembly.

3.2 DOCUMENTATION REQUIREMENTS

The management approach for accomplishing the Performance Verification Program shall be described in Section 3 of the Performance Assurance Implementation Plan (paragraph 1.3). In addition, the following specifications, plans, procedures, and reports are required for defining the technical aspects of the Performance Verification Program. The verification plan is required first, followed by a detailed specification, followed by detailed procedures at the time of need.

3.2.1 Verification Plan and Procedure

A Verification Plan shall be prepared that defines the tests and analyses that collectively demonstrate that the hardware complies with Sections 3.3 through 3.7 of this document.

The Verification Plan shall provide the overall approach to accomplishing the verification program. For each test, it shall include the level of assembly, configuration of the item, objectives, facilities, instrumentation, safety consideration, contamination control, test phases and profiles, necessary functional operations, personnel responsibilities, and requirements for procedures and reports. It shall also define a rationale for retest determination that does not invalidate previous verification activities. The interaction of the test and analysis activity shall be described.

For each analyzed activity, the plan shall include objectives, a description of the mathematical model, assumptions on which the models will be based, required output, criteria for assessing the acceptability of the results, the interaction with related test activity, if as, and requirements for the resultant verification reports.

As an adjunct to the Verification Plan, a test matrix shall be prepared that summarizes all tests that will be performed on each flight recorder and its components.
For each functional and environmental test activity conducted at the recorder and its component levels, Verification Procedures shall be prepared that describe how each test activity contained in the Verification Specification and Verification Plan will be implemented.

The procedures shall describe details such as instrumentation monitoring, facility control sequences, test article functions, test parameters, quality control checkpoints, data collection, and reporting requirements. The procedures shall also address safety and contamination control provisions. Verification Procedures at the subsystem and recorder levels shall be submitted to POES in accordance with Appendix C.

3.2.3.1 Control of Unscheduled Activities During Verification--An operational procedure shall be established for controlling, documenting and approving all activities that are not part of an approved procedure.

The contractor shall be alert to the hazard potential of last-minute changes and shall institute controls at appropriate management levels for preventing accident or injury or hardware damage. The control procedure shall be contained in the Performance Assurance Implementation Plan (paragraph 1.3).

3.2.4 Verification Reports

After completion of each subassembly and recorder verification activity, a report shall be submitted in accordance with Appendix C. The report shall contain, as a minimum, the information described in the sample test report (Figure 3-1). For each analysis activity, the report shall describe the degree to which the objectives were met, how well the test data validated the mathematical model, and other significant results.

In addition, as-run verification procedures, as well as all test and analysis data, shall be made available for review at the contractor's facility on request.

3.3 ELECTRICAL FUNCTION TEST REQUIREMENTS

3.3.1 Electrical interface Tests

Before the integration of a subassembly or component into the next higher hardware assembly,-electrical interface tests shall be performed to verify acceptability.

PERFORMANCE VERIFICATION

DOCUMENTATION

VERIFICATION TEST REPORT (Continued)

Page___of___

Date (add time for thermal and temperature tests)	Note beginning and end of actual activity, deviations from the planned procedure, and discrepancies in test times performance. (State if there were no deviations or discrepancies.)	Malfunction Report Number and Date (if applicable)
	(use additional paper as required)	

The activities covered by these reports include tests and measurements performed for the purpose of verifying the flightworthiness of hardware at the component, subsystem, and payload levels of assembly. These reports shall also be provided for such other activities as the project may designate.

These reports shall be completed and transmitted to the GSFC Technical Officer or Contracting Officer (as appropriate) within 30 days after the completion of an activity. Legible, reproducible, handwritten completed forms are acceptable.

Material felt necessary to clarify this report may be attached. However, in general, test logs and data should be retained by those responsible for the test unless they are specifically requested.

The forms shall be signed by the quality assurance representative and the person responsible for the test item or his designated representative; the signatures indicate concurrence that the data is as accurate as possible given the constraints of time imposed by quick-response reporting.

This report does not replace the need for maintaining complete logs, records, etc.; it is intended to document the implementation of the verification program and to provide a minimum amount of information as to the performance of the test item.

Figure 3-1. Sample Test Report (Sheet 1 of 2)

PERFORMANCE VERIFICATION

DOCUMENTATION
Page___of___

VERIFICATION TEST REPORT

PROJECT _____

TEST ITEM _____

MANUFACTURER _____

SERIAL NUMBER _____

LEVEL OF ASSEMBLY: ☐ COMPONENT ☐ SUBSYSTEM ☐ PAYLOAD

TYPE HARDWARE: ☐ PROTOTYPE ☐ PROTOFLIGHT ☐ FLIGHT ☐ SPARE

TYPE TEST:

- ☐ STRUCTURAL LOADS
- ☐ PRESSURE PROFILE
- ☐ THERMAL - VACUUM
- ☐ VIBRATION
- ☐ MASS PROPERTIES
- ☐ THERMAL BALANCE
- ☐ ACOUSTICS
- ☐ ELECTROMAGNETIC COMPATIBILITY
- ☐ THERMAL CYCLING
- ☐ MECHANICAL SHOCK
- ☐ MAGNETIC PROPERTIES
- ☐ TEMPERATURE - HUMIDITY
- ☐ MECHANICAL FUNCTION
- ☐ LEAKAGE
- ☐ MODAL SURVEY
- ☐ COMPREHENSIVE PERFORMANCE
- ☐ OTHER (explain) _____

VERIFICATION PROCEDURE NO. _____ REV. _____ DATE _____

☐ INITIAL TEST

☐ RETEST (☐ PARTIAL OR ☐ FULL; STARTING DATE OF INITIAL TEST_____)

APPLICABLE VERIFICATION PLAN: _____

FACILITY DESCRIPTION: _____

LOCATION: _____

TEST LOG REFERENCE: _____

COMMENTS:

SIGNATURE:

QUALITY ASSURANCE REPRESENTATIVE: _____ DATE _____

COGNIZANT ENGINEER FOR TEST ITEM: _____ DATE _____

Figure 3-1. Sample Test Report (Sheet 2 of 2)

During integration, the electrical harnessing shall be tested to verify that electrical signals are properly routed. All such testing, as well as the accompanying integration activities, shall be performed in an area that conforms to the cleanliness criteria developed in response to Section 9.

3.3.2 Performance Tests

3.3.2.1 Comprehensive Performance Tests--When the recorders are completed, a comprehensive performance test (CPT) shall be conducted on each hardware element. When environmental testing is performed, additional comprehensive performance tests shall be conducted during the hot and cold extremes of the temperature or thermal-vacuum test and at the conclusion of the environmental test sequence, as well as at other times that shall be defined in the Verification Specification.

The comprehensive performance test shall be a detailed demonstration that the hardware meets its performance requirements within allowable tolerances. The test shall demonstrate that all redundant circuitry is operating and that the hardware is performing satisfactorily in all operational modes. The initial CPT shall serve as a baseline against which the results of all later CPTs shal be compared.

Limited life electrical items shall be included in the Limited Life Tests as required in Section 7 of this document. For items for which it is determined that life testing is not required, the rationale for such determination shall be provided along with a description of the analyses that will be conducted during the course of the program to verify the validity of such a determination.

3.3.2.2 Limited Performance Tests--Limited performance tests shall be performed before, during, and after environmental tests, as appropriate, to demonstrate that the environmental tests have not degraded the functional capability of the hardware.

Limited performance tests shall also be used in cases for which comprehensive performance testing is not warranted or not practicable. Specific times at which limited performance tests will be performed shall be defined in the Verification Specification.

3.3.2.3 Trouble-free Performance Testing--At the conclusion of the performance verification program recorders shall have demonstrated minimum reliability acceptability by trouble-free performance testing for at least the last 100 hours of testing. Trouble-free operation during the thermal vacuum test exposure may be included as part of the demonstration. Major hardware changes

during or after the verification program shall invalidate previous demonstration.

3.4 STRUCTURAL AND MECHANICAL REQUIREMENTS

3.4.1 General Requirements

The contractor shall demonstrate compliance with structural and mechanical requirement with a series of interdependent test and analysis activities. The demonstrations shall verify design and specified factors of safety, ensure interface compatibility, and acceptable workmanship. Unchanged designs of hardware shall not require re-analysis except for the effects of different launch vehicle loads and environments.

3.4.2 Requirement Summary

Table 3-1 specifies the required structural and mechanical verification activities. When planning the tests and analyses, the contractor shall consider all expected environments, including that of structural loads, vibroacoustics, and pressure profiles and shall verify the mass properties and mechanical functioning.

3.4.3 Structural Loads

3.4.3.1 VERIFICATION--Verification for the structural-load environment shall be accomplished by a combination of test and analysis. Testing is required (i.e., modal survey, sine sweep, etc.) to verify that the analytic model of the hardware adequately represents its dynamic characteristics. The test-verified model shall then be used to predict the maximum expected load for each potentially critical loading condition, including handling, transportation, and vibroacoustic effects during liftoff. The maximum loads that result from the analysis shall define the limit loads.

The usual method of verifying adequate strength is to apply a set of loads equal to 1.25 times the limit loads after which the hardware must be capable of meeting its performance criteria. The strength verification test must be accompanied by a stress analysis that predicts that ultimate failure will not occur at loads equal to 1.40 times the limit load.

When minor structural modifications are made and stringent quality-control procedures are invoked to ensure conformance of the structure to the design, then strength verification may be accomplished by a stress analysis that demonstrates that the hardware will meet its performance criteria after being subjected to a load equal to 2.O times the limit load.

When composite materials are used in the structure, analytic strength verification shall not be used. The wider ranges of strength associated with composite structures must be taken into account by additional demonstrations, such a development tests, proof tests, and larger design factors. The use of material that are susceptible to brittle fracture or stress-corrosion cracking require the development of and strict adherence to special procedures to prevent problem.

3.4.3.2 Acceptance Requirements--Structural load test requirement do not apply for the acceptance testing of previously qualified hardware, except that structural element- fabricated of composite material shall be proof tested to the limit load.

3.4.7 Pressure Profile

3.4.7.1 Verification--The need for a pressure profile test shall be assessed for all recorders. A verification test shall be performed if analysis does not indicate a positive margin at loads equal to twice those induced by the maximum expected pressure differential during launch. If a test is required, the limit pressure profile is determined by the predicted pressure/time profile for the nominal trajectory of the particular mission. Because pressure-induced loads vary with the square the rate of change, the verification pressure profile is determined by multiplying the predicted pressure rate of change by a factor of 1.12 (the square root of 1.25, the required verification factor on load).

3.4.7.2 Acceptance Requirements--Pressure profile test requirements do not apply for the acceptance testing of previously qualified hardware.

3.4.8 Mass Properties

Because hardware mass property requirements are mission-dependent, they shall be determined on a case-by-case basis. The mass properties program shall include an assessment of the recorder’s ability to comply with the mission requirements.

Table 3-1
Structural and Mechanical Requirements

Requirement	Recorder
Structural Loads	T2
Vibroacoustics	
Sinuoidal Vibration	T
Random Vibration	T
Pressure Profile	A, Tl
Mass Properties	A, M

M - - Measurement.

T -- Test required.

Tl -- Test must be performed if indicated by analysis or other considerations.

A -- Analysis required.

T2 -- Test required for new or modified design or for increased loads changed environment.

3.5 ELECTROMAGNETIC COMPATIBILITY REQUIREMENTS

3.5.1 General Requirements

The electromagnetic characteristics of hardware shall be such that:

a. The recorder and its elements shall not generate Electro-Magnetic Interference (EMI) that could adversely affect its own component, other recorders, the spacecraft, or the safety and operation of the launch vehicle and launch site.

b. The recorder and its components shall not be susceptible to emissions that could adversely affect their safety and performance.

3.5.2 Specific Requirements

The contractor shall demonstrate compliance with the general requirements of the LMCS Unique Instrument Interface Specification (UIIS), IS 2295548.

3.5.3 Magnetic Properties

The contractor shall maintain magnetic properties control to the extent necessary to meet LMCS Unique Instrument Interface Specification (UIIS), IS 2295548.

3.6 VACUUM, THERMAL, AND HUMIDITY REQUIREMENTS

3.6.1 General Requirements

The following recorder (or recorder equipment) capabilities shall be demonstrated to satisfy the vacuum, thermal, and humidity requirement:

a. The recorder shall perform satisfactorily in the vacuum and thermal environment of space.

b. The hardware shall withstand, a necessary, the temperature and humidity conditions or transportation, storage, launch, and operational use.

3.6.2 Requirement Summary

Table 3-2 summarizes the test and analyze that collectively will serve to fulfill the general requirements of paragraph 3.6.1. Tests noted in the table may require supporting analyze and vice versa. The contractor shall determine the order in which the demonstration are conducted.

Table 3-2
Vacuum and Thermal Requirements

Requirement	Recorder
Thermal Vacuum	T
Thermal Balance	T/A

T -- Test required.

T/A -- Test is highly desirable; analysis is mandatory.

3.6.3 Thermal-Vacuum

3.6.3.1 General Requirements--The thermal-vacuum test shall demonstrate the ability of the hardware to perform satisfactorily in functional modes representative of the mission in vacuum at the nominal mission operating temperature, at a temperature margin of +10°C beyond the mission allowable temperature limit for hardware utilizing passive thermal control, and during temperature transitions.

The recorder shall be subjected to the thermal vacuum temperature cycle specified in Appendix D. The recorder shall be exposed for a minimum of 16 hour at each temperature extreme. Turn-on capability shall be demonstrated under vacuum at least once at low temperature.

Hardware that is determined to be insensitive to vacuum effect may be temperature cycled at normal room pressure in an air or gaseous nitrogen environment; items that are tested shall be subjected to the profiles in Appendix D.

Temperature excursions during cycling of hardware shall be large enough to detect latent defects in workmanship. Hardware shall be exposed for a minimum of 4 hour at each extreme of each temperature cycle as specified in Appendix D.

During the cycling, the hardware shall be operating and performance shall be monitored. Outgoing procedure that are found to be necessary (see Section 9) shall be made part of the thermal-vacuum test operations.

3.6.3.2 Acceptance Requirement--The thermal vacuum test shall be designed to produce the temperature extreme expected in orbit as a minimum.

3.6.3.3 Additional Report Requirement--The thermal-vacuum verification report shall include actual achieved test temperatures and pretest predicted temperature. A detailed explanation shall be provided for any cases that differ by more than 5°C.

4. SYSTEM SAFETY REQUIREMENTS

4.1 GENERAL REQUIREMENTS

The safety effort is a logical flow-down from the safety program to be implemented on the spacecraft. The recorder contractor shall plan and conduct a system safety program that:

a. Provides for the identification of hazards to personnel, facilities, support equipment, launch vehicle, and mission hardware during all stages of the program life.

b. Satisfies the applicable guidelines, constraints, and requirement stated in the following documents (Appendix A):

   (l) E&WR 127-1, Eastern and Western Range Safety Requirements, Range Safety Regulation, March 1995.

   (2) MIL-STD-1574A, System Safety Program for Space and Missile System, August 15, 1979.

c. Interfaces effectively with the industrial safety requirement of the contract.

4.2 SYSTEM SAFETY PROGRAM PLAN

The contractor shall prepare and submit a System Safety Implementation Plan (SSIP) that constitutes Section 4 of the Performance Assurance Implementation Plan (paragraph 1.3).

The Plan shall describe the safety program requirements and implementation procedures that the contractor will invoke to ensure the identification and control of hazards to personnel and hardware during fabrication, tests, transportation, ground processing, and launch activities

4.3 ANALYSES

4.3.1 SYSTEM HAZARD ANALYSES

During the contract effort, the contractor shall develop analyses for identifying the hazards associated with the hardware, support equipment, and their interfaces. Documentation shall be in accordance with MIL-STD-1574A. The contractor shall take measures to minimize each significant identified hazard.

All hazards that affect personnel, the recorder, or other hardware shall be identified. Hazard reports shall be submitted as a part of a safety data package at CDR to document the identification, causes, control, and verification methods for each hazard.

4.3.2 OPERATIONS HAZARDS ANALYSES

When the use of a facility in the performance of an activity could result in subjecting hardware or personnel to hazard, an Operations Hazard Analysis (OHA) shall be performed to identify the hazards and to document the requirement for either eliminating or adequately controlling each hazard. For example, operation that may require analysis including handling, transportation, functional tests, and environmental test. A report of each OA performed shall be submitted in accordance with Appendix C.

4.4 HAZARD CONTROL VERIFICATION

The control of all hazards shall be verified by test, analysis, inspection, similarity to previously qualified hardware, or any combination of these activities.

4.5 WAIVERS

When a specific safety requirement cannot be met, the contractor shall submit a waiver request to POES in accordance with Appendix C. Each waiver request shall address only one hazard and shall be submitted as soon a it is determined that one is required.

4.6 SAFETY DATA PACKAGE

The contractor shall submit to POES a safety data package that applies to the program at the time of the CDR. The contents of each package shall show status of compliance with the requirements of E&WR 127-1. Each package should include an adequate technical and functional description of the hardware. Also provided shall be the completed analyses results (as a minimum, a system hazard as well a the OHA), any hazard reports, and waiver requests.

5. PARTS CONTROL REQUIREMENTS:

5.1 GENERAL REQUIREMENTS

The contractor shall plan and implement an Electrical, Electronic, and Electromechanical (EEE) Parts Control Program to assure that all parts selected for use in flight hardware meet mission objectives for quality and reliability. The contractor shall prepare a Parts Control Plan (PCP) describing the approach and methodology for implementing the Parts Control Program. The PCP shall be made a part of the proposal for review in accordance with contract delivery requirements.

5.2 ELECTRICAL, ELECTRONIC, AND ELECTROMECHANICAL (EEE) PARTS

All part commodities identified in the GSFC Preferred Parts List (PPL) are considered EEE parts and shall be subjected to the requirements set forth in this section. Custom or advanced technology devices such as custom hybrid microcircuits, detectors, Application Specific Integrated Circuits (ASIC), and Multi-Chip Modules (MCM) shall also be subject to parts control appropriate for the individual technology (see 5.2.2.1).

5.2.1 Parts Control Board

The contractor shall establish a Parts Control Board (PCB) or a similar documented system to facilitate the management, selection, standardization, and control of parts and associated documentation for the duration of the contract. The PCB shall be responsible for the review and approval of all parts for conformance to program requirements, and for developing and maintaining a Program Approved Parts List (PAPL). In addition, the PCB shall be responsible for all parts activities such as failure investigations, disposition of non-conformances, and problem resolutions. PCB operation procedures shall be included as part of the PCP.

5.2.1.1 PCB Meetings

PCB meetings shall be convened on a regular basis or as needed. Meeting minutes or records shall be maintained by the contractor to document all decisions made and a copy provided to GSFC within three days of convening the meeting. GSFC shall retain the right to overturn decisions regarding non-conformances within ten days after receipt of meeting minutes. GSFC may participate in PCB meetings and shall be notified in advance of all upcoming meetings. PCB activities may be audited by GSFC on a periodic basis to assess conformance to the contractor’s PCP.

5.2.2 Parts Selection and Processing

All parts shall be selected and processed in accordance with the GSFC 311-INST-001 Instructions for EEE Parts Selection, Screening and Qualification. Part quality level shall be Grade 2. All application notes in 311-INST-001 shall apply. Contractor's internal selection and processing documentation may be used if determined by the PCB to be consistent with 311-INST-001 for the specific mission level. Exceptions to 311-INST-001 shall be identified in the PCP.

5.2.2.1 Custom Devices

In addition to applicable requirements of 311-INST-001, any custom microcircuits, hybrid microcircuits, MCM, ASIC, etc. planned for use by the contractor shall be subjected to a design review. The review may be conducted as part of the PCB activity. The design review shall address, at a minimum, derating of elements, method used to assure each element reliability, assembly process and materials, and method for assuring adequate thermal matching of materials.

5.2.3 Derating

All EEE parts shall be used in accordance with the derating guidelines of the PPL. The contractor's derating policy may be used in place of the PPL guidelines and shall be submitted with the PCP.

5.2.4 Radiation Hardness

All parts shall be selected to meet their intended application in the predicted mission radiation environment. The radiation environment consists of two separate effects, those of total ionizing dose and single-event phenomena. The contractor shall document the analysis for each part with respect to both effects.

5.2.5 Verification Testing

Verification of screening or qualification tests are not required unless deemed necessary as indicated by failure history, GIDEP Alerts, or other reliability concerns. If required, testing shall be in accordance with 311-INST-001 as determined by the PCB.

5.2.6 Destructive Physical Analysis

A sample of each lot date code of microcircuits, hybrid microcircuits, and semiconductor devices shall be subjected to a Destructive Physical Analysis (DPA). All other parts may require a sample DPA if it is deemed necessary as indicated by failure history, GIDEP Alerts, or other reliability concerns. DPA tests, procedures, sample size and criteria shall be as specified in GSFC specification S-311-M-70, Destructive Physical Analysis. Contractor's procedures for DPA may be used in place of S-311-M-70 and shall be submitted with the PCP. Variation to the DPA sample size requirements, due to part complexity, availability or cost, shall be determined and approved by the PCB on a case-by-case basis.

5.2.7 Parts Age Control

Parts drawn from controlled storage after 5 years from the date of the last full screen shall be subjected to a full rescreen and sample DPA. Alternate test plans may be used as determined and approved by the PCB on a case-by case basis. Parts over 10 years from the date of the last full screen or stored in other than controlled conditions where they are exposed to the elements or sources of contamination shall not be used.

5.3 PARTS LISTS

The contractor shall create and maintain a Program Approved Parts List (PAPL) and a Parts Identification List (PIL) for the duration of the program. The contractor may choose to incorporate the PAPL and PIL into one list, which shall be submitted to GSFC as a PIL, provided clear distinctions are made as to parts approval status and whether parts are planned for use in flight hardware.

5.3.1 Program Approved Parts List

The Program Approved Parts List (PAPL) shall be the only source of approved parts for flight hardware, and as such may contain parts not actually in flight design. Only parts that

have been evaluated and approved by the PCB shall be listed in the PAPL. Parts must be approved for listing on the PAPL before initiation of procurement activity. The criteria for PAPL listing shall be based on 311-INST-001 and as specified herein (see 5.2.2). The PCB shall assure standardization and the maximum use of parts listed in the PAPL. The PAPL and all subsequent revisions shall be available for GSFC review upon request.

5.3.1.1 Parts Approved on Prior Programs

Parts previously approved by GSFC via the contractor's Nonstandard Parts Approval Request (NSPAR) on the preceeding contract for a system similar to the one being procured shall be evaluated by the PCB for continued compliance to current program requirements prior to listing in the PAPL. This shall be accomplished by determining that:

a. No changes have been made to the previously approved NSPAR, Source Control Drawing (SCD) or vendor list.

b. All stipulations cited in the previous NSPAR approval have been implemented on the crrent flight lot, including performance of any additional testing.

5.3.2 Parts Identification List

As opposed to the PAPL, the Parts Identification List (PIL) shall list all parts planned for use in flight hardware, regardless of their approval status. The initial PIL and subsequent updates shall be submitted to GSFC in accordance with the contract delivery requirements. An As-Built Parts List (ABPL) shall also be prepared and submitted to GSFC in accordance with the contract delivery requirements. The ABPL is generally the final PIL with additional as-built information.

5.4 Alerts

The contractor shall be responsible for reviewing and dispositioning all Government Industry Data Exchange Program (GIDEP) Alerts for applicability to the parts proposed for use. In addition, any NASA Alerts and Advisories provided to the contractor by GSFC shall be reviewed and dispositioned.

6. MATERIALS, AND PROCESSES CONTROL REQUIREMENTS

The contractor shall implement a comprehensive Materials and Processes Program, beginning with the design stage of the hardware.

6.1 SECTION REQUIREMENTS

6.1.1 Conventional Applications

Selection of material and processes shall be based upon past performance, available data, or current tests. The contractor shall be guided by the applicable documents listed in Appendix A.

6.1.2 Nonconventional Applications

Any use of a material for which there is a lack of aerospace experience shall be considered a nonconventional application. In that case, the material shall be verified for the desired application on the basis of similarity, analysis, test, inspection, existing data, or a combination of these methods.

6.1.3 Special Problem Areas

The contractor shall give special attention to problem areas such as radiation effects, stress/corrosion cracking, galvanic corrosion, hydrogen embrittlement, lubrication, contamination of cooled detectors, and weld-heat-affected zones. Critical high-strength fasteners and pressurized systems shall be reviewed from a fracture mechanics viewpoint before they are accepted for use.

6.1.4 Organic Materials

The outgassing characteristica of organic materials in vacuum shall be a prime consideration in selection. Only organic materials with a Total Mass Loss (TML) of less than 1.00 percent and a Collected Volatile Condensable Material (CVCM) of less than 0.10 percent when tested in accordance with ASTM E595-77 (Appendix A) shall be used

6.1.5 Considerations in Process Selection

Manufacturing proceses shall be carefully selected if they are the type that may substantially change a material's properties (e.g., heat treatment, welding, or chemical or metallic coatings).
The objectives are to maintain the integrity of the materials and to avoid introducing property changes that could cause adverse effects.

6.1.6 Shelf-Life Controlled Items

In processes that involve polymeric materials whose uncured constituents have a limited shelf life (as indicated by the manufacturer's literature), some latitude will be granted for the use of date-coded expired materials if certain requirements are met. The contractor ssall prove to POES by means of appropriate tests that the properties of the materials have not been compromised for their intended use. The data from the tests must be submitted in accordance with Appendix C. Fabricated items such as "O" rings that have out-of-date codes shall not be installed in flight hardware.

6.2 MATERIALS REVIEW

A contractor materials engineer shall review the applications of the proposed materials and procasses on the basis of engineering drawings before approving their use. He shall also audit and consult with all subtier contractors and vendors to assure himself that the materials and processes are acceptable for the applications involved.

6.3 DOCUMENTATION

The following information shall be submitted to GSFC in accordance with Appendix C.

a. Data that supports unusual application.

b. Engineering drawings for materials application.

c. Inorganic Materials List--This list shall be prepared and documented on GSFC Form 18-59A (Figure 6-1).

d. Polymeric Materials List--This list shall be prepared and documented on GSFC Form 18-59B (Figure 6-2).

e. Lubrication List--This list shall be prepared and documented on GSFC Form 18-59C (Figure 6-3).

f. Materials Processes List--This list shall be prepared and documented on GSFC Form 18-59D (Figure 6-4).

g. Contamination Control Program--The cleanliness levels achieved on contract NAS5-29230 shall be required on all flight models delivered for this contract. Contamination levels and verification measurements from as flown STR-108 (AT) recorders shall be delivered with the proposal.

The contractor may use his own system of reporting if it provides all the information requested by the GSFC forms.

GSFC SPACECRAFT INORGANIC(1) MATERIALS LIST

SPACECRAFT ______________ SYSTEM/EXPERIMENT ______________ GSFC T/O ______________

CONTRACTOR ______________ ADDRESS ______________

PREPARED BY ______________ PHONE ______________ DATE PREPARED ______________

GSFC MATERIALS EVALUATOR ______________ PHONE ______________ DATE RECEIVED ______________ DATE EVALUATED ______________

ITEM NO	MATERIAL IDENTIFICATION(2)	CONDITION(3)	APPLICATION(4)	EXPECTED ENVIRONMENT(5)	GSFC EVALUATION(6)		
					A	NA	SA

NOTES

(1) List all inorganic materials (metals, ceramics, glasses, liquids) except bearing and lubrication materials which should be listed on form GSFC 18-59C.

(2) Give name of material, identifying number, manufacturer.
E.g., Aluminum 6061-T6
Electroless nickel plate, Enplate Ni-410, Enthone, Inc.
Fused silica, Corning 7940, Corning Glass Works.

(3) Give details of the finished condition of the material, heat treat designation (hardness or strength), surface finish and coating, cold worked state, welding, brazing, etc.
E.g., Heat treated to R_c 60 hardness, gold electroplated, brazed
Surface coated with VDA and MgF_2
Cold worked to Full Hard condition and welded by TIG process, electroless nickel plate.

(4) Give details of where on the spacecraft the material will be used (component) and its function.
E.g., Electronics box structure in attitude control system, not hermetically sealed.

(5) Give the details of the environment the material will experience as a finished S/C component, both in ground test and in space. Exclude vibration environment. List all materials with the same environment in a group.
E.g., T/V: -20°C/+60°C, 2 weeks, 10^{-5} torr, UV
Storage: up to 1 year at RT
Space: -10°C/+20°C, 2 years, 150 mi. alt., UV, electron, proton

(6) Evaluator's comments to be filled in by GSFC evaluator. A = approved, NA = not approved, SA = see attached document for further comments.

Figure 6-1. GSFC Spacecraft Inorganic Materials List

GSFC SPACECRAFT POLYMERIC[1] MATERIALS LIST

SPACECRAFT ______ SYSTEM/EXPERIMENT ______ GSFC T/O ______

CONTRACTOR ______ ADDRESS ______

PREPARED BY ______ PHONE ______ DATE PREPARED ______

GSFC MATERIALS EVALUATOR ______ PHONE ______ DATE RECEIVED ______ DATE EVALUATED ______

AMOUNT CODE		
Area, cm^2	Vol., cc	Wt., gm
1 0-1	A 0-1	a 0-1
2 2-100	B 2-50	b 2-50
3 101-1000	C 51-500	c 51-500
4 >1000	D >500	d >500

ITEM NO	MATERIAL IDENTIFICATION[2]	MIX FORMULA[3]	CURE[4]	AMOUNT CODE	EXPECTED ENVIRONMENT[5]	REASON FOR SELECTION[6]	GSFC EVALUATION[7] A	NA	SA

NOTES

(1) List all polymeric (organic) materials total systems except lubrication materials which should be listed on form GSFC 18-59C.

(2) Give name of material, identifying number, manufacturer.
E.g., Epoxy, Epon 828, Shell Chem., Co.

(3) Provide proportions and name of resin, hardener (catalyst), filler, etc.
E.g., 828/V140/Silflake 135 as 5/5/38 bwt.

(4) Provide cure cycle details.
E.g., 8 hrs @ RT + 2 hrs @ 150°C

(5) Provide the details of the environment the material will experience as a finished S/C component, both in ground test and in space. Exclude vibration environment. List all materials with the same environment in a group.
E.g., T/V: -20°C/+60°C, 2 weeks, 10^{-5} torr, UV
Storage: up to 1 year at RT
Space: -10°C/+20°C, 2 years, 150 mi. alt., UV, electron, proton

(6) Provide any special reason(s) why the material was selected. If for a particular property, please give the property.
E.g., Cost and availability
RT curing and low expansion

(7) Evaluator's comments to be filled in by GSFC evaluator. A = approved, NA = not approved, SA = see attached document for further comments.

Figure 6-2. GSFC Spacecraft Polymeric Materials List

GSFC SPACECRAFT LUBRICATION LIST

SPACECRAFT _____ SYSTEM/EXPERIMENT _____ GSFC T/O _____

CONTRACTOR _____ ADDRESS _____

PREPARED BY _____ PHONE _____ DATE PREPARED _____

GSFC MATERIALS EVALUATOR _____ PHONE _____ DATE RECEIVED _____ DATE EVALUATED _____

ITEM NO	COMPONENT TYPE, SIZE, MATERIAL[1]	COMPONENT MANUFACTURER & MFR IDENTIFICATION	PROPOSED LUBRICATION SYSTEM & AMT OF LUBRICANT	TYPE & NO OF WEAR CYCLES[2,3]	SPEED, TEMP., ATM OF OPERATION[3]	TYPE OF LOADS & AMT.[4]	OTHER DETAILS[5]	GSFC EVALUATION[6]		
								A	NA	SA

NOTES

(1) BB = ball bearing, SB = sleeve bearing, G = gear, SS = sliding surfaces, SEC = sliding electrical contacts. Give generic identification of materials used for the component, e.g., 440C steel, PTFE.

(2) CUR = continuous unidirectional rotation, CO = continuous oscillation, IR = intermittent rotation, IO = intermittent oscillation, SO = small oscillation (<30°), LO = large oscillation (>30°), CS = continuous sliding, IS = intermittent sliding.
No. of wear cycles: A($1-10^3$), B(10^3-10^4), C(10^4-10^6), D($>10^6$)

(3) Speed: RPM = revs/min., OPM = oscillations/min., VS = variable speed
CPM = cm/min. (sliding applications)
Temp. of operation, max. & min., °C
Atmosphere: vacuum, air, gas, sealed or unsealed & pressure

(4) Type of loads: A = axial, R = radial, T = tangential (gear load). Give amount of load.

(5) If BB, give type and material of ball cage and number of shields and specified ball groove and ball finishes. If G, give surface treatment and hardness. If SB, give dia. of bore and width. If torque available is limited, give approx. value.

(6) Evaluator's comments to be filled in by GSFC evaluator. A = approved, NA = not approved, SA = see attached document for further comments.

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Figure 6-3. GSFC Spacecraft Lubrication List

GSFC SPACECRAFT MATERIALS PROCESSES LIST

SPACECRAFT ______ SYSTEM/EXPERIMENT ______ GSFC T/O ______

CONTRACTOR ______ ADDRESS ______

PREPARED BY ______ PHONE ______ DATE PREPARED ______

GSFC MATERIALS EVALUATOR ______ PHONE ______ DATE RECEIVED ______ DATE EVALUATED ______

ITEM NO	PROCESS TYPE (1)	CONTRACTOR SPEC NO (2)	MIL, ASTM, FED, OR OTHER SPEC NO	DESCRIPTION OF MAT'L PROCESSED (3)	SPACECRAFT/EXP APPLICATION (4)	GSFC EVALUATION (5)		
						A	NA	SA

NOTES

(1) Give generic name of process, e.g., anodizing (sulfuric acid).

(2) If process is proprietary, please state so.

(3) Identify the type and condition of the material subjected to the process
E.g., 6061-T6

(4) Identify the component or structure of which the materials are being processed.
E.g., Antenna dish

(5) Evaluator's comments to be filled in by GSFC evaluator. A = approved, NA = not approved, SA = see attached document for further comment.

GSFC 18-59D 3/78

Figure 6-4. GSFC Spacecraft Materials Processes List

7. RELIABILITY REQUIREMENTS

7.1 GENERAL REQUIREMENTS

The contractor shall plan and implement a Reliability Program that interacts with assurance for design, parts, materials testing, and other space project activities.

7.2 DESIGN ASSURANCE

7.2.1 Requirements

The contractor shall establish design criteria and shall standardize and control design practices. The designs shall be capable of:

a. Functioning properly during the required mission lifetime.

b. Minimizing or eliminating potential sources of human-induced failures.

c. Permitting ease of assembly, test, fault isolation, repair, servicing, and maintenance without compromising safety, reliability, quality, and performance.

7.2.2 Contractor Support for Design Assurance

Contractor design and quality assurance personnel shall specifically ensure that:

a. The detailed design is in accordance with the controlling design criteria.

b. All processes and operations in which uniform high quality cannot be ensured by inspection alone are identified and controls are established to ensure hardware integrity.

7.2.3 Specifications, Drawings, and Test Procedures

7.2.3.1 Design Specifications-- The contractor shall write a design specification for each item of hardware at the system, subsystem, and component levels. Each design specification shall identify the physical and functional requirements and interfaces of the specified system.

7.2.3.2 Specifications, drawings, and Test Procedure Reviews-- The contractor shall ensure that all design specifications, drawings, and test procedures are independently reviewed before release. The review shall ensure that the documents cover all items of hardware at the appropriate levels, that each is complete in its contents, and that each is functionally and physically consistent with interfacing design specifications, drawings, and procedures. Reviews shall also be conducted for changes to the document.

7.3 RELIABILITY ANALYSES

Reliability analyses shall be performed on all new or modified components. The existing analyses for previously designed/flown hardware must be updated each time they are impacted.

7.3.1 Failure Mode, Effects, and Criticality Analysis

A failure Mode, Effects, and Criticality Analysis (FMECA) shall be performed to identify potential critical and catastrophic failures so that susceptibility to the failures and their effects can be eliminated from the system. A listing of all failure modes and the severity level of the failure's effects shall be provided. Catastrophic failures are defined as failures that prevent the achievement of mission success. Critical failures are defined as those that significantly degrade the achievement of mission success. The analysis shall be performed early in the design phase for all electrical and electromechanical flight hardware. In accordance with Appendix C, the FMECA shall be updated at specific milestones and as required by design changes and other pertinent data or events.

Analysis of redundant equipment shall address crosstrapping to ensure that a single failure will not adversely affect the performance of the redundant capability. Recorder interface analyses shall ensure that a single failure will not affect the spacecraft. No single failure shall prevent the successful removal of power from a failed recorder. Potential critical and catastrophic failures that cannot be eliminated from the system shall be itemized on a Critical Items List that shall be attached to the FMECA. Justification for the retention of each item listed shall be included.

The FMECA, together with the attached Critical Items List and updates, shall be submitted to GSFC in accordance with Appendix C.

7.3.2 Parts and Devices Stress Analyses

Electrical, Electronic, and Electromechanical (EEE) parts and devices, as applied in circuits within each component, shall be subjected to stress analyses for conformance with the derating guidelines of MIL-STD-975 and the GSFC PPL. The analyses shall-be performed at the most stressful part-level parameter values that can result from the specified performance and environmental requirements on the assembly or component. The analyses shall be performed in close coordination with the packaging reviews and shall be required input data for component-level design reviews (paragraph 2.5). The stress analyses shall be documented and updated as stated in Appendix C.

7.3.3 Worst-Case Analyses

Worst-case analyses shall be performed for critical parameters that are subject to variations that could degrade performance. Adequacy of margins in the design of electronic circuits, optics, and electromechanical and mechanical items shall be demonstrated by analyses and/or test. The analyses shall consider all parameters set at worst-case limits and worst-case environmental stresses for the parameter or operation being evaluated. The analyses shall be updated as part of the design changes. Both the analyses and updates shall be submitted for review to POES.

7.3.4 Trend Analyses

The contractor shall assess all subsystems and components (including old, new, and modified designs) to determine the measurable parameters that relate to performance stability. These parameters shall be monitored for trends starting at component acceptance testing and continuing during the system integration and test phases of the recorder. The parameters shall be monitored within the normal test framework (i.e., during functional tests, environmental tests, etc.). The contractor shall establish a system for recording and analyzing the parameters and any changes from the nominal, even if the levels are within specified limits. A list of parameters to be monitored and the trend analysis reports shall be submitted in accordance with Appendix C. Trend analysis data shall be reviewed with the operational personnel before launch, and the operational personnel shall continue to record the trends throughout the life of the mission.

7.4 LIMITED-LIFE ITEMS

Limited-life items shall be identified on a Limited-Life List and shall be submitted in accordance with Appendix C. The list shall include the expected life and the rationale for selecting each item. Limited-life items, include all hardware that is subject to degradation because of age, operating time, or cycles such that its expected useful life is less than twice the required life when fabrication, test, storage, and mission operation are combined.

7.5 RELIABILITY OF GOVERNMENT-FURNISHED PROPERTY (GFP)

When the overall system includes components or subsystems furnished by POES, the contractor shall be responsible for obtaining from the POES Project Office adequate reliability data on the items. The data will be used for performing the FMECA. When the contractor’s examination of the data or testing indicates that the reliability of GFP in inconsistent with the requirements of the overall system, the POES Project Office shall be formally and promptly notified.

8. QUALITY ASSURANCE REQUIREMENTS

8.1 GENERAL REQUIREMENTS

The contractor shall establish, document, and ensure compliance with design control requirements and quality criteria during all phases of contract work.

8.2 DOCUMENT CHANGE CONTROL

Quality assurance personnel shall ensure that documents and changes are controlled in accordance with the contractual configuration management requirements. The contractor shall ensure that the effectivity of documents and changes are clearly specified, changes are accomplished on affected articles, and changed articles are appropriately identified. Documents shall be kept current, and all fabrication, inspections, and tests shall be performed according to the applicable drawings and changes. The inspection record of the product shall indicate the change level which applies.

The issue numbers of the drawings and specifications to which the particular hardware has been fabricated, inspected, and tested shall be documented as the as-built configuration. Evidence shall be provided of compliance with the as-built documentation as a basis for acceptance of the hardware. This information shall be submitted as part of the Acceptance Data Package (paragraph 8.23).

A contractor QA representative shall be a member of the contractor's board that controls configuration changes. The QA activities shall be defined in the Configuration Management Plan.

8.3 IDENTIFICATION AND TRACEABILITY

8.3.1 Requirements

The contractor shall maintain a product identification and tracking system. Each product shall be identified by a unique part or type number, consistent with the configuration management system for the contract. Where control of individual products or lots of products is required, date codes, lot numbers, serial numbers and lot numbers shall be assigned.

The configuration management system shall be capable of retrieving the identification and serialization record at the subassembly level. Beginning at the subassembly level and continuing though the end product, the system shall be capable of tracing backward to the originating subassembly and forward to the location of the subassembly at any give level of process, assembly, or test.

Identification and serialization data lower than that for subassemblies shall be maintained in the manufacturing and processing records and shall contain data code, lot numbers, and manufacturer of the item. The contractor is encouraged to make use of his existing identification and traceability system. Serial numbers of scrapped products shall not be reused.

8.4 PROCUREMENT CONTROLS

The following detailed quality assurance requirements shall be included or referenced in the procurement documents, as applicable, in addition to those requirements selected in conformance with paragraph 1.8.2.

8.4.1 Product Changes

The supplier shall notify the contractor of proposed changes to products (including changes in design, fabrication methods or processes, and changes which may affect the quality or intended end use of the item.) The supplier shall submit these changes to the contractor for processing in accordance with the contractor's proprietary item. The supplier shall also notify the contractor of those changes.

8.4.2 Purchased Raw Materials

Raw materials purchased by the contractor shall be accompanied by the results of chemical and physical tests or a certificate of compliance. When material is purchased for critical design applications (as defined in the FMECA), the supplier shall be required to furnish specimens for chemical and physical tests.

8.4.3 Raw Materials Used in Purchased Products

The supplier shall document and make available to the contractor upon request the results of acceptance tests and analyses performed on critical (as defined in the FMECA), raw materials.

8.4.4 Age Control and Limited-Life Products

Records shall be kept on products that have definite characteristics of quality degradation or drift with use or age. The records shall note the date, test time, or cycle when useful life was initiated, the life or cycles used, and the date and test time or cycle when useful life will be expanded.

8.4.5 Inspection and Test Records

The contractor shall specify that the supplier maintain inspection and test records as evidence of results. The contractor shall also specify records that are to be provided with the deliverable item.

8.4.6 Government Source Inspection (GSI)

When the government elects to perform inspection at a supplier's plant in accordance with paragraph 8.7, the following statement shall be included in the procurement document:

“All work on this order is subject to inspection and test by the government at any time and place. The government quality representative who has been delegated for NASA quality assurance, shall be notified immediately upon receipt of this order. The government representative shall also be notified 48 hours in advance of the time that articles or materials are ready for inspection or test.

8.4.7 Procurements That Do Not Require GSI

Procurements that do not require GSI shall include the following statement:

“The government has the right to inspect any or all of the work included in this order at the supplier's plant.”

8.4.8 Weld Filler Metal

Weld rods, weld wire, and such procurements shall meet the requirements of MSFC-STD-655 (Appendix A).

8.4.9 Fasteners

Procurement, application, screening, inspection and test of fasteners shall conform with the requirements of GSFC specification S-313-100.

8.4.10 Contractor QA Activity at Source

When contractor QA activity is required at a supplier’s plant as determined by paragraph 8.8, the procurement document shall so indicate.

8.4.11 Resubmission of Nonconforming Articles or Materials

Nonconforming articles and materials returned to the supplier by the contractor and subsequently resubmitted by the supplier shall bear adequate identification of such resubmission. Reference shall be made to the contractor’s nonconformance document and evidence provided that the causes for the nonconformance have been corrected and actions have been taken to preclude recurrence.

8.5 REVIEW AND APPROVAL OF PROCUREMENT DOCUMENTS

Quality assurance personnel shall review and approve procurement documents before they are released to ensure that applicable requirements of this document are included. These reviews shall be documented.

8.6 GOVERNMENT SOURCE INSPECTION

The contractor shall forward procurement documents to the government representative for review so that he can ensure compliance with controlling documentation and determine the need for GSI. Such Government inspection shall not replace contractor source inspection or relieve the contractor of his responsibilities for product reliability, quality, and safety.

8.7 CONTRACTOR SOURCE INSPECTION

The contractor shall perform source inspection at the subcontractor's or supplier facilities when one or more of the following conditions exist:

a. In-process, end-item controls, or tests that are destructive in nature prevent the contractor from verifying quality in his plant.

b. It is not feasible or economical for the contractor to determine the quality of procured articles solely by inspections or tests performed at his plant.

c. Qualification tests are to be performed by the subcontractor or supplier.

d. Products are shipped directly from the source to user, bypassing the contractor's inspection facilities.

8.8 CONTRACTOR RECEIVING INSPECTION

All procured products shall be processed through an incoming inspection and testing system prior to fabrication. Nondestructive Evaluation (NDE) may be used if controlled documentation and certified personnel are employed. The receiving inspection system shall consist of the following:

a. Procured products shall indicate evidence of inspections and tests performed by the suppliers in accordance with the purchase requirements and shall be accompanied by the required data directly traceable to the products. The records shall give evidence of contractor and Government source inspection.

b. Inspections and tests shall be conducted in accordance with written procedures on selected characteristics of the products to verify their acceptability. Particular emphasis shall be placed on the selection of characteristics that have not been contractor-source inspected and those for which nonconformances are difficult to detect during subsequent inspection and test. Test results shall be compared on a sample basis with test results provided by the supplier. Disassembly shall be performed periodically for detailed verification when required by the procurement document or the procedures.

c. The supplier's age control and limited-life product records shall be updated to reflect the receiving inspection activity.

d. When required by procurement documents, chemical and physical tests shall be conducted on supplier-furnished specimens or on randomly selected samples of material having critical design applications. When acceptance is based upon a supplier's Certificate of Compliance (COC), chemical analyses or physical tests shall also be conducted on randomly selected samples from each lot of materials to verify the COC. It shall be verified that all weld filler metal is in compliance with MSFC-STD-655.

e. Products and their records shall show acceptance or noncon-formance status when released from receiving inspection, and the products shall be protected for subsequent handling or storage. Nonconforming products shall be submitted for MRB action. Items awaiting inspection or test results shall be identified.

f. Sampling inspection shall be made of items such as nuts, bolts, and fasteners that are not used as critical attachments. Receiving inspection and test records shall be maintained, including copies of documents submitted by the supplier.

8.9 FABRICATION CONTROL

8.9.1 Fabrication and Assembly Flow Plan

In addition to the general performance assurance requirements set forth in Section 1 (paragraphs 1.3 through 1.9), the contractor shall develop a Fabrication and Assembly Flow Plan that covers all operations (from start of fabrication to delivery) including the inspections and tests, GSI points, and all special processes to be used. A preliminary flow plan and a final flow plan shall be submitted in accordance with Appendix C.

8.9.2 Documentation

The contractor shall use a documentation system (consisting of items such as fabrication orders, assembly orders, shop travelers, and repair procedures) to control the flow of hardware through the manufacturing phase. Controls shall ensure that only the conforming product is released and used during fabrication and that those products not required for the operation involved are removed from the work area and properly stored. Fabrication documents shall include or reference the following:

a. Nomenclature and identification of the article

b. Tooling, jigs, fixtures, and other equipment to be used

c. Characteristics and tolerances to be obtained

d. Detailed procedures for controlling processes

e. Special condition to be maintained, such as environmental conditions or precautions to be observed

f. Workmanship standards

g. Controls for parts, materials, and articles that have definite characteristics of quality degradation or drift with age, including requirements for recording and maintaining dates, time, or cycles for determining end of life.

h. Traceability to the individual performing each fabrication and assembly operation. Where a team is involved the team leader shall be identified.

Contractor assurance personnel shall ensure that manufacturing operations are in compliance with up-to-date controlling documents.

8.9.3 Fabrication Requirements

The requirements of NHB 5300.4(3A-2), NAS 5300.4(3G-1), NHB 5300.4(3H), and NAS 5300.4(3J-1), (Appendix A), shall be implemented. Surface Mount Technology will be in accordance with LMCS document K10046440 and NAS 5300.4 (3M) (with exception to NHB 5300.4 (3L)). Printed wiring boards shall be in accordance with requirements of S-312-P-003, and MIL-STD-275/ANSI-IPC-D-275 (see section 8.15.3.5). Workmanship standards may be used to show acceptance criteria. When samples showing acceptance criteria are necessary, they will be jointly selected by the contractor and NASA or its quality representative. Standards shall be kept current and shall be used to train, certify, and recertify personnel when appropriate. NASA Standards NASA-STD-8739.1, 8739.2, 8739.3 and 8739.4 shall be considered equivalent for personnel certification and/or recertification.

8.9.4 Process Evaluation and Control

Controls shall be implemented for processes for which uniform high quality cannot be ensured by inspection of products alone. NDE methods may be used if controlled documentation and certified personnel are employed. Process procedures shall be prepared and shall describe the following:

a. Preparation of the processing equipment, solutions, and materials

b. Preparation of the products to be processed

c. Detailed processing operations

d. Conditions to be maintained during each phase of the process, including environmental controls

e. Methods of verifying the adequacy of processing materials, solutions, equipment, environments, and their associated control parameters

f. Inspection and test provisions

g. Records for documenting the results of process inspection, test, and verification

The contractor shall provide for the certification of equipment used in selected processes. Records that certify test results shall be maintained. Equipment shall be recertified as indicated by the results of quality surveys, inspections, or tests, or when changes are made that may affect process integrity.

8.10 CONTAMINATION CONTROL

Quality assurance personnel shall ensure compliance with the requirements of the Contamination Control Plan (Section 9).

8.11 ELECTROSTATIC DISCHARGE CONTROL

The contractor shall implement a program to control Electrostatic Discharge (ESD) for electrical and electronic parts, assemblies, and equipment susceptible to damage caused by static electricity. The program shall address provisions for work area protection, handling procedures, training, intra-plant protective covering, packaging for delivery, and Quality Assurance verification of conformance.

The program shall provide for the identification and labeling of all ESD sensitive hardware and for the use of protective packaging and/or methods to reduce static charges so as to minimize the likelihood of ESD damage. The contractor shall also invoke applicable requirements for ESD control on subcontractors and suppliers.

8.12 NONCONFORMANCE CONTROL

The contractor shall operate a closed-loop nonconformance control system for failures and discrepancies. The system shall include provisions for the following:

a. Documentation of each nonconformance traceable to the specific product on which it occurred

b. Assignment of a unique and traceable document number for each failure and for those discrepancies designated for Material Review Board (MRB) action

c. Description of the nonconformance and the required characteristic or design criteria

d. Conducting and documenting analyses and examinations to determine the cause

e. Conducting and documenting timely and effective remedial and preventive action on the products and applicable documents

f. Disposition of the nonconforming product

g. Signatures of authorized personnel on the appropriate nonconformance documents

h. Accumulating data in summary reports

I. Performing analyses from the part level of assembly and higher to identify adverse trends and to provide for their correction

j. Closeout of nonconformance documentation after verifying that effective remedial and preventive actions have been taken

Upon request, a report of the analyses required by items d and i shall be made available to POES. Products that depart from specified requirements shall be identified and, if practicable, shall be isolated for review action. The system shall include provisions for controlling nonconforming products that cannot be isolated from the normal channels of manufacture.

8.12.1 Control, Disposition, and Reporting of Discrepancies

8.12.1.1 Documentation--Control of discrepancies shall begin with the receipt of procured parts, materials, or other products or with the initiation of in-house manufacturing, whichever occurs first. Each discrepancy shall be documented on the appropriate contractor form as soon as it is discovered.

8.12.1.2 Initial Review Dispositions--Discrepant products shall be reviewed by contractor QA and, as appropriate, engineering personnel and shall be subjected to one of the following dispositions:

a. Return for Rework or Completion of Operations--The product shall be returned using established and approved documents and operations. During rework, the product shall be resubmitted to normal inspection and tests.

b. Scrap in Accordance with Government-Approved Contractor Procedures.

c. Return to Supplier--The contractor shall provide the supplier with the nonconformance information assistance that is necessary for remedial and preventive action.

d. Submit to Material Review Board--When the dispositions described above are not appropriate, the discrepant products shall be submitted to the MRB for final disposition.

Products disposed of without referral to the MRB shall be subject to review by the government quality representative. Initial review dispositions shall be recorded on nonconformance documentation.

8.12.1.3 Material Review Board--An MRB shall be formed and shall operate as follows:

a. Membership--As a minimum, the MRB shall comprise the following members:

(1) Contractor quality representative (Chairman)

(2) Contractor engineering representative

(3) Government quality representative

b. Responsibilities--The MRB shall have the responsibility to:

(1) Determine disposition of submitted products. All MRB decisions must be unanimous.

(2) Ensure that remedial and preventive actions, including reinspection and retest requirements, are recorded on the nonconformance document before disposition.

(3) Perform trend analysis of discrepancies.

(4) Ensure that MRB records are maintained.

c. Dispositions--In addition to the dispositions listed in paragraph 8.12.1.2, the MRB shall have authority for the following:

(1) Repair-- The MRB shall approve repairs, except as follows. Standard repair procedures shall be submitted to POES for approval. The MRB shall authorize the use of non-standard procedures for each instance of repair. The MRB shall ensure that the hardware reliability and quality are not compromised by excessive repairs. (See Note)

(2) Scrap

(3) Use-As-Is:

(a) Use-as-is disposition does not adversely affect the safety, reliability, durability, performance, interchangeability, weight, or other basic features of the hardware.

(b) Dispositions that, in the opinion of the MRB, will adversely affect any of the foregoing or which are contrary to any of the requirements of the contract must be submitted as a waiver request to the contracting officer for approval in accordance with the project Configuration Management Plan (paragraph 8.3).

Note: The products shall be withheld from further processing in a controlled area until direction for disposition is given.

8.12.1.4 Supplier Material Review Board--With approval of POES or its authorized quality representative, the contractor may delegate MRB responsibility to suppliers.

8.12.2 Control, Reporting, and Disposition of Failures

8.12.2.1 Failure Reporting. A Problem/failure Report (PFR) shall be written for each departure from design, performance, testing, or handling requirements that affects the function of the recorder or could possibly compromise mission objectives. This includes portions of the test equipment (GSE) that interfaces with and

supply power to the flight equipment. These requirements shall be flowed-down by the contractor to major subcontractors (i.e, greater than $100K).

Other problems or anomalies that are unusual or that might affect other areas shall also be cited on a PFR.

Reporting of hardware failures shall begin with the first power application at the lowest level of assembly or the first operation of a mechanical item; it shall continue through formal acceptance by the NASA project office and the postlaunch operations, as required by the contract.

For software problems, operation of this PFR system shall begin with the first test use of the software item with a hardware item of the mission system at the component level or higher.

a. Report Processing- A PFR shall be initiated immediately after the failure has occurred. (See Figure 8-1a for a sample report form). The contractor / subcontractor may use his existing form for reporting if it complies with the requirements of the GSFC PFR form and is approved by POES. The report shall be filled out in accordance with the instructions on Figure 8-1b.

   It shall be given an Failure Effect Rating as soon as practicable (see par. 8.13.2.3), to be labeled and noted in Block 32 of the form. It shall also be given a Failure Corrective Action Rating as soon as the failure has been analyzed and the corrective action devised. This shall be noted in Block 33 of the form in accordance with the Risk Rating criteria stated in paragraph 8.13.2.3, below. The Failure Corrective Action Rating shall be updated if appropriate, based on technical re-assessment prior to close-out and this final Failure Corrective Action Rating noted by updating Block 33 of the form.

   The reports shall be submitted to NASA in accordance with Appendix C, and the identical information shall be given to the in-plant Government quality representative. The PFR data shall be submitted in hard copy. The hard copy submittals shall be made as the updating actions occur on each PFR, and the iteration submitted to NASA for closure shall include a copy of all referenced data and shall have had all corrective actions accomplished and verified.

   The contractor shall maintain a master report file which contains all supplementary data such as failure analysis and records of meetings.

   In lieu of reporting in accordance with the above format and content, the contractor may provide direct access to his internal failure reporting system.

b. Status Summaries- A summary of the open PFR's shall be submitted as part of the Performance Assurance Status Report (see section 1.6). The summaries shall list each problem or failure as a separate line item and provide complete identification of the affected hardware (part and serial numbers), the environment, date of occurrence, and a brief description of the failure, its cause, and the corrective action to be taken. Before removing any item from the "open" list, the last summary report shall show the corrective actions actually taken and the date closed.

8.12.2.2 Failure Review Board. A Failure Review Board (FRB) shall be established and, as a minimum, shall comprise the following:

a. Contractor quality or reliability representative (chairman).

b. Contractor project manager or his representative.

c. Contractor engineering representative who is responsible for the failed item.

d. Government quality representative.

The contractor shall select members on the basis of technical competence. The Government representative on the board shall approve the membership.

The FRB shall obtain the assistance of appropriate groups and personnel to ensure that all failures are investigated, analyzed, and their causes determined. Failures involving EEE parts shall be coordinated with the PCB (see section 5). Investigations and

actions shall be coordinated with NASA and documented on a PFR. Trend analysis shall be performed and corrective action taken. Where it is determined that the affected item is discrepant, the FRB will refer it to the MRB for disposition in accordance with paragraph 8.12.1.3.

Closeout of each failure shall require verification that remedial and preventive actions have been accomplished in the item on which the failure occurred, that necessary preventive design changes in the item have been accomplished and verified in test, and that effectivity of preventive actions has been established in other affected items.

The FRB chairman, denoting approval of the entire Board, shall sign the PFR closeout before submitting it to NASA in accordance with Appendix C. In addition, "Red Flag" reports shall be signed off as prescribed in par. 8.13.2.3. PFR's shall not be considered closed until signed by the authorized Government representative.

8.13 ALERT INFORMATION

POES may provide the contractor with Alerts that document problems with parts, materials, processes, and safety as reported through the Government-Industry Data Exchange Program (GIDEP) or the source. In accordance with Appendix C, the contractor shall submit Responses to Alerts, which inform POES of the applicability of the problem to project hardware and any follow-up action proposed. Status summaries that cover each Alert received in a 30-day period shall be submitted as part of the Performance Assurance Status Report (paragraph 1.6).

The contractor shall prepare Alerts on parts, material, or manufacturing process problems that are within the scope of the Alert and safety system.

A Safe-Alert must be prepared to report significant safety problems in which loss of life, injury of personnel, or damage to or loss of property have or could have occurred.

If the contractor participates in the GIDEP, he shall submit a copy of the Alert to POES. If he does not participate in the GIDEP, he shall prepare Alerts (DD Form 1938, Figures 8-4 and 8-5) and submit them together with supporting data to POES in accordance with Appendix C.

8.14 INSPECTION AND TESTS

The contractor shall plan and conduct an inspection and test program for demonstrating that contract, drawing, and specification requirements are met. Inspections and tests shall be performed on products before they are installed in the next level of assembly. These inspections shall include a review of product records. Each inspection and test shall be traceable to the individual responsible. All manufacturing documentation shall be approved prior to use.

PROBLEM / FAILURE REPORT

(1) TEST ELEMENT:	FLT ☐ HDW ☐ SW	GRD ☐ HDW ☐ SW	TEST ☐ HDW ☐ SW	PFR No.					Contactor Report No.					
(2) Project		(3) Spacecraft/Observatory			(4) Operating Time			(5) No. of Cycles						
(6) Sub-System/Instrument	(7) S/W Version	(8) Date & Time of Problem/Failure	Yr	Mo	Day	Time	(9) Date of Report	Yr	Mo	Day				
(10) Originator (Last Name, First Name)		Phone (xxx/yyy-yyyy)					Organization (GSFC Code or Company)							
(11) Run Test ID														
(12) Supporting Information	[ ] Console Printout	[ ] Dump Printout	[ ] Error Codes	[ ] Dump Tape No.	[ ] Criticality	[ ] Other								
(13) Problem/Failure Occurred During	[ ] Bench/Unit Test [ ] Qualification Test	[ ] Integration Test [ ] Acceptance Test	[ ] Pre-Launch Operations [ ] Launch Operations	[ ] Other										
(14) Environment When Failed	[ ] Acceleration [ ] Shock	[ ] Thermal-Vacuum [ ] Temperature	[ ] Humidity [ ] Vibration	[ ] Ambient [ ] Vibration	[ ] EMI EMC [ ] Magnetics									
(15) Hardware/Integration Level When Failed	[ ] Part [ ] Sub-Assembly	[ ] Assembly [ ] Component	[ ] Spacecraft Sub-system [ ] Instrument/Experiment	[ ] Spacecraft/Observatory										
(16) Software/Integration Level When Failed	[ ] OS [ ] User Interface	[ ] Database [ ] Driver	[ ] Communications [ ] Firmware	[ ] Test [ ] Other _____										
	NAME	IDENTIFICATION/REVISION NO.	SERIAL NO.	MANUFACTURER	CAGE CODE									
(17) Component														
(18) Assembly														
(19) Sub-Assembly														
(20) Part		Manufacturer's Part Number	Date Code											
(21) Description of the Problem/Failure (attach additional sheets if necessary):														
(22) Reference: Certification Log Book # _____ Page _____ Test Procedure _____ Para _____														
(23) Cause of the Problem/Failure (attach additional sheets if necessary):														
(24) Correction Action Taken (attach additional sheets if necessary):														
(25) If Corrective Action is Required on Other Units, List Units by Serial No.														
(26) Failure Analysis Performed [ ] Yes [ ] No [ ] N A	Failure Analysis Performed by GSFC Code Contractor _____ Failure Analysis Report Number _____													
(27) Action Taken on Failed Unit [ ] Rework [ ] Modified [ ] Discard [ ] Replace [ ] None [ ] PSMB/CCB [ ] Submit to MRB	Organization That Performed Rework/Repair _____ MRB No. _____ Date: _____													
(28) Is Retest Required After Corrective Action? [ ] Yes [ ] No	If Yes, State Retest Requirements	Date Completed												
(29) Is Unit Suitable for Original Use: [ ] Yes [ ] No	Remarks:													
(30) Contractor Program Manager FRB Approval	Signature _____ Date: _____	OA Signature _____ Date: _____												
(31) Safety [ ]	(32) Failure Effect Rating [ ]	(33) Failure Corrective Action Rating [ ]	(34) Red Flag [ ] Yes [ ] No											
(35) GSFC Project Manager Approval	Date:	(36) GSFC OFA Approval	Date Closed											

GSFC 4-2 (4/93)

Figure 8-1a GSFC Problem/Failure Report Form (Copy 1)

Block (1) Check appropriate block for element being tested.
P/FR #: Leave blank. # generated by computer when input into system. Contractor Report #: All off site contractor initiators fill in with the contractor unique tracking #.

Block (2) All initiators, use project approved acronym or project name.

Block (3) All initiators, provide the project approved acronym or complete name of the spacecraft or observatory on which problem occurred.

Block (4) Enter the elapsed time to the point where problem occurred to the tenth of hour.

Block (5) If testing in cycles, enter the number of cycles elapsed to the point where the problem/failure occurred.

Block (6) All initiators, enter system or experiment name. Definitions: "System" - The next functional subdivision of a spacecraft generally composed of two or more components designed to perform an operation. Example: Electrical Communication system, Stabilization and Control system, etc. "Experiment" - The next functional subdivision of a spacecraft, generally a combination of two or more components, including both the sensor and associated electronics designed for acquisition of data for space research.

Block (7) For software testing - enter the configuration nomenclature for the item being tested.

Block (8) Enter date & time of problem/failure. Example - June 8, 1967 at 3 p.m. - Year 67, Month 06, Day 08, Time 1500.

Block (9) Enter date the problem/failure report is originated. Example June 9, 1967 - Year 67, Month 06, Day 09.

Block (10) Enter the complete: last and first name, telephone number and organization (GSFC Code or Company) of the P/FR initiator.

Block (11) For software enter the ID # of Run Test.

Block (12) For software check the appropriate item, enter the appropriate dump tape number and enter the correct criticality code C U R, Critical, Urgent, Routine.

Block (13) Check the appropriate item indicating the type of test being conducted when the problem/failure occurred. If other is checked, describe in Block (21).

Block (14) Check item that defines the actual environment the unit was being subjected to when the problem/failure occurred. Caution for example, do not check vibration if unit failed during a function test prior to the actual application of the vibration environment, check ambient. If the environment in which the unit failed is not listed or the description listed does not give sufficient detail, give this information in Block (21).

Block (15) Check item that defines the hardware level at the time of problem/failure. For example: If a power supply subassembly fails during communications systems test, check spacecraft sub-system.

Block (16) Check item that defines the software level at time of problem/failure If other is checked, describe in Block (21).

Blocks (17-20) Initiators provide cage code if known or leave blank.

Block (17) Enter component name. Definition: "Component" - The next functional subdivision of a system which is generally a self-contained combination of assemblies performing a function necessary to the systems operations. Example: Power, power supply, transmitter, gyro package, etc. Enter component identification no., serial no., the manufacturer's name, and the manufacturer s cage code.

Block (18) Enter assembly name. Definition: "Assembly" - The next functional subdivision of a component which consists of parts or subassemblies which perform functions necessary to the operation of the component as a whole. Example: Regulator assembly, power amplifier assembly, etc. Enter the assembly identification no., serial no., manufacturer's name, manufacturer's cage code.

Block (19) Enter subassembly name. Definition: "Subassembly" - An assembly within a larger assembly. Example: Wired printed circuit board modules, etc. Enter subassembly identification no., serial no., manufacturer's name, manufacturer s cage code.

Block (20) Enter part name. Definition: "Part" - An element of a component, assembly or subassembly which is not normally subject to further subdivision or disassembly without destruction of designed use. Example: Resistors, transistors, diodes, etc. Enter manufacturer s part number, the manufacturer s name, date code, and manufacturer s cage code.

Block (21) Enter all details of the problem/failure such, as inputs, outputs, tolerances, symptoms, abnormal conditions, testing phase, detail of environment and prior environment. Use additional sheets if necessary.

Block (22) Enter reference information.

Block (23) Enter detailed, concise narrative defining the actual direct cause of the problem/failure. Use additional sheets if necessary.

Block (24) Enter detailed, but concise, narrative defining the corrective action taken. The corrective action shall be sufficient to preclude the problem/failure from occurring again. Use additional sheets if necessary.

Block (25) List other units affected by the corrective action. Enter N/A if not applicable.

Block (26) Check appropriate item and fill in requested information if appropriate.

Block (27) Check appropriate item(s) and fill in requested information.

Block (28) Check appropriate item and detail which tests if any need to be re-run. Enter date retest completed if required.

Block (29) Check appropriate item and provide supporting rationale, if any.

Block (30) GSFC hardware/software contractors (program manager/FRB chairman) fill out this block at completion of all actions.

Blocks (31-36) are for GSFC Project Failure Review Board use only. Refer to FAP P-303-849.

Block (31) Check if failure involves a safety related item.

Block (32) Choose appropriate: 1 - None or negligible, 2 - Moderate or significant, 3 - Major or catastrophic

Block (33) Choose appropriate: 1 - Known cause/certainty in corrective action, no possibility of recurrence; 2 - Unknown cause/certainty in corrective action, no possibility of recurrence, 3 - Known cause/uncertainty in corrective action, some possibility of recurrence, or 4 - Unknown cause/uncertainty in corrective action, some possibility of recurrence

Block (34) Check Yes or No based on conditions of Blocks #32, #33 Refer to FAP P-303-849

Block (35) GSFC project manager approval

Block (36) GSFC project FAM approval to close

Figure 8-1b Instructions for entering data on the GSFC Problem/Failure Report Form

8.14.1 Planning

The contractor shall plan for inspections and tests and for a documentation system that substantiates their accomplishment. The planning function shall provide for:

a. Orderly and timely inspection and tests at the earliest opportunity and throughout all phases

b. Coordination and sequencing of inspection and tests conducted at successive levels of assembly to ensure satisfactory articles and materials and to eliminate unnecessary testing

c. Availability of handling equipment and calibrated inspection and test equipment

d. Coordination of inspections and tests conducted by the designated Government Quality Representative

8.14.2 Inspection and In-Process Test Procedures

Inspection shall be conducted in accordance with documented procedures physically located at the applicable inspection station. The degree of detail in the inspection procedure shall be commensurate with the complexity of inspection operations. Procedures shall include, as applicable, the nomenclature of the article, characteristics to be inspected, accept/reject criteria, and special consideration regarding measuring equipment, standards, safety, and environment.

8.14.3 Inspection Activity

8.14.3.1 In-Process Inspection-- In-process inspection shall be performed at all levels of assembly in keeping with the following requirements:

a. The configuration, drawing requirements, and workmanship shall be verified before the next step of fabrication or integration.

b. In-process inspection shall be done in a clean environment in accordance with the Contamination Control Plan.

c. In-process inspection personnel shall be certified for selected processes and inspections.

d. In-process verification below the component level shall include electrical interface tests (paragraph 3.3.1) of subassemblies and assemblies prior to being integrated into the next higher level of hardware.

8.14.3.2 Final Inspection--Final inspection shall be performed at all levels of assembly as follows:

a. Configuration, workmanship, and test results shall be verified before installation or use with the next higher level of assembly.

b. Assurance personnel shall verify that records are complete.

c. Same as 8.14.3.1(b).

d. Same as 8.14.3.1(c).

8.14.3.3 End-Item Inspection--End-item inspection shall be performed to:

a. Verify that configuration, test results, workmanship, and the Acceptance Data Package is in compliance with the contract.

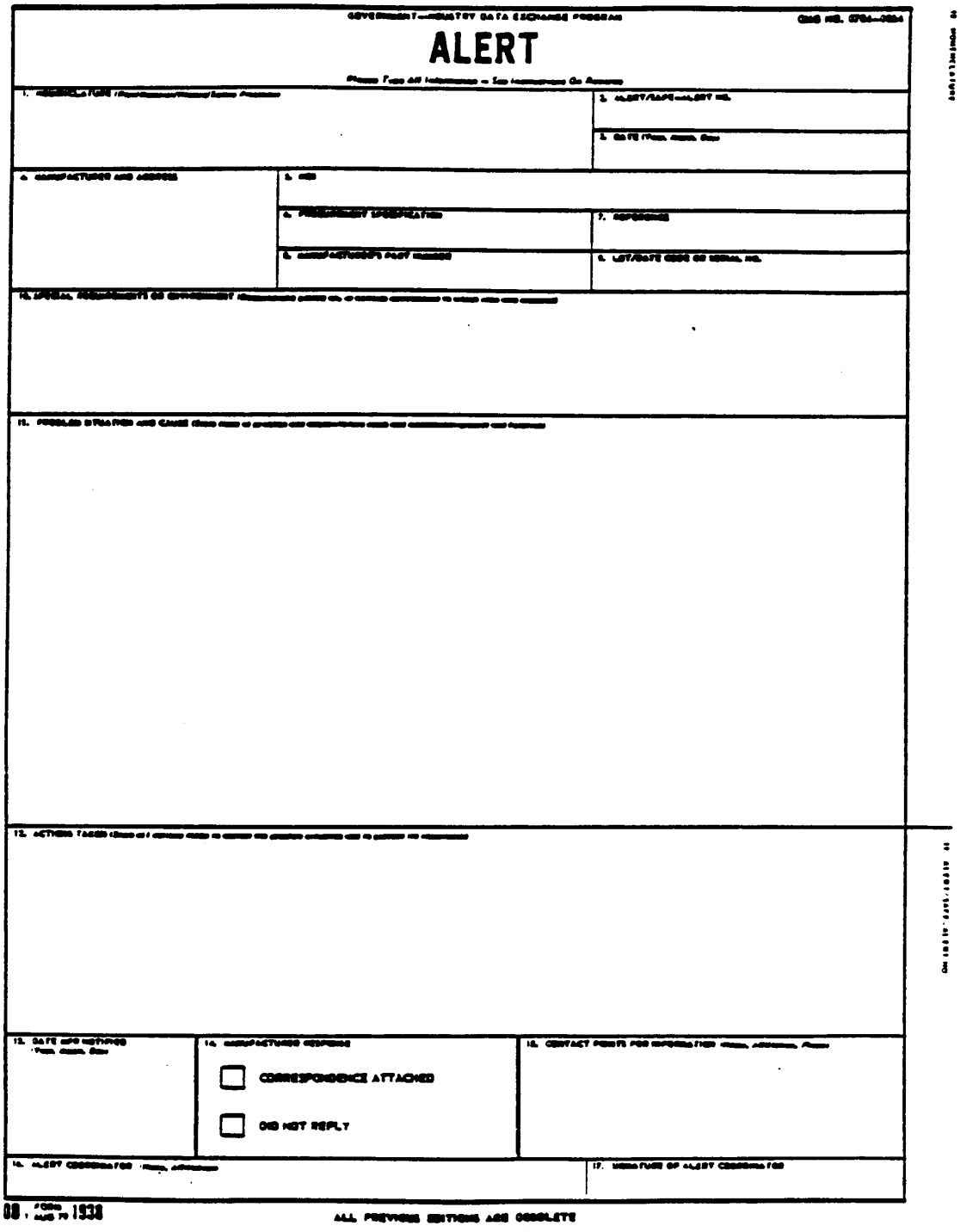
b. Verify that POES has authorized the delivery of the end item with any open nonconformances and unresolved tasks that may exist.

8.14.3.4 Printed wiring Board Inspections and Tests. Printed wiring boards shall conform to the requirements of S-312-P-003, and MIL-STD-275/ANSI-IPC-D-275, and shall be qualified by test and inspection results. Test coupons from each lot of multi-layer PWB's shall be submitted to NASA for evaluation. Coupons shall be identified, as a minimum, with drawing number, revision, board manufacturers lot date code or plating lot code and as applicable, subcontractors traceability or control identification. The coupons are to be submitted for evaluation prior to flight board population. Coupons from all other printed wiring boards shall be retained for submittal to NASA for evaluation upon request.

8.14.4 QA Activities During Integration and Test Phase

Assurance personnel shall ensure that the subassemblies, assembles, components, and contract end-items are integrated and tested in accordance with controlling documents. Articles undergoing test shall not be adjusted, modified, repaired, reworked, or replaced except as specified in established documents, or in accordance with MRB actions. The status, configuration, and integrity of the hardware must be maintained and documented.

Assurance personnel shall provide surveillance of all tests, the extent of which shall be defined in QA and test documents by quality assurance management. As a minimum, the activities in the following paragraphs shall be performed.



ALERT

CORRESPONDENCE ATTACHED

DID NOT REPLY

ALL PREVIOUS EDITIONS ARE OBSOLETE

Figure 8-4. Alert Form

INSTRUCTIONS FOR PREPARING ALERT FORM

1. NOMENCLATURE – Enter noun subset category classification and function information. This is obtained from Section 12 of the Government–Industry Data Exchange program (GIDEP) Policies and Procedures (P&P) Manual.

2. ALERT/SAFE ALERT NO. – Use originator's code assigned by GIDEP. Enter letter "A" for ALERTS or letter "S" indicating SAFE ALERT when subject or ALERT affects health or safety of personnel who may come in contact with defective part or unit if it is assembled into. The letter is followed by last two digits of year and then by consecutive sequence number of all ALERTs initiated by the originator for that year. An addendum is indicated by adding a change letter (A, B, or C, as required) to the sequence number. For example: XX–A–77–02A is ALERT number for addendum to second ALERT in 1977 by an originator with code XX.

3. DATE – This is date ALERT is released by ALERT Coordinator. Have coordination procedures in 13. Each addendum should have new release date.

4. MANUFACTURER AND ADDRESS – List actual manufacturer of item. Also enter Manufacturer's Federal Code Number (MFCN) from Federal Handbook H4–1 or H4–2. When available, also enter Contract Administration Services Code Number (CASN) from DOD 4105.59–H. If supplied from source other than manufacturer and this is pertinent, also list the source here or in Block 18. If ALERT is against a category or application, do not identify manufacturer.

5. NATIONAL STOCK NUMBER – (Formerly Federal Stock Number.) List applicable number. If several numbers are applicable and space is not available, place asterisk after last number and continue entry in Block 18. As a minimum, enter Federal Supply Class.

6. PROCUREMENT SPECIFICATION – List applicable procurement specification and name of issuing organization. Include, in Block 18, nearest government or industry specification and any exceptions or special requirements government or industry specification requirements which were imposed.

7. REFERENCE – List any applicable documentation not included as part of this ALERT, e.g., previous ALERT number, TWX, or report number.

8. MANUFACTURER'S PART NUMBER – List manufacturer's catalog identification/part number of item. If different than procurement specification identification, list nearest similar manufacturer's identification and list differences in Block 11.

9. LOT/DATE OR SERIAL NO. – When problem is applicable to only certain lot/date code or serial numbered items, list appropriate code or number. Use your purchase if other information is not available. Blank space indicates "all."

10. SPECIAL REQUIREMENTS OR ENVIRONMENT – State any special requirements placed on item or any special or extreme environment to which it was subjected. This would include any exceptions or requirements other than imposed in applicable procurement specification listed in Block 6.

11. PROBLEM SITUATION AND CAUSE – State facts of problem and cause, including failure mode and mechanism.

12. ACTIONS TAKEN – State all actions taken to correct problem situation and to prevent further occurrences. This will include any actions taken by manufacturer, if known.

13. DATE MANUFACTURER NOTIFIED – Release of ALERT requires that a copy be sent to manufacturer identified in Block 4 and fifteen (15) working days be allowed for a reply. When available, attach a copy of the reply to the ALERT.

14. MANUFACTURER RESPONSE – Item manufacturer must be notified. When manufacturer correspondence is included, check CORRESPONDENCE ATTACHED entry. When manufacturer does not reply, check DID NOT REPLY entry. If ALERT is against a category or application and manufacturer is not identified, enter N/A in CORRESPONDENCE ATTACHED entry.

15. CONTACT POINTS FOR INFORMATION – Enter name, affiliation, and telephone number of persons to contact for further information. This may include designated personnel from ALERT originator's organization, or any other organization.

16. ALERT COORDINATOR – Enter name and affiliation of the ALERT Coordinator.

17. SIGNATURE – Signature of ALERT Coordinator.

18. NOMENCLATURE – Same as in Block 1.

19. ALERT/SAFE–ALERT NO. – Same as in Block 2.

Figure 8-5. Instructions for Alert Form

8.14.4.1 Verification--Before testing, the assurance personnel shall verify:

a. The presence of approved inspection and test documents

b. The identification of products

c. The configuration of products

d. That test equipment is within the calibration period for the duration of the test

e. Test setup and test configuration

8.14.4.2 Test Documentation--During tests, the assurance personnel shall:

a. Ensure that tests are conducted in accordance with approved specifications and procedures.

b. Ensure accurate and complete recording of data and results.

c. Document rework, repairs, or modifications.

d. Document nonconformances.

8.14.4.3 Post-Test Assurance Activity--Subsequent to testing, the assurance personnel shall:

a. Verify by visual inspection that tested articles are not damaqed or deteriorated as a result of testing.

b. Ensure proper disposition of articles.

c. Verify that test results, reports, and nonconformance documents are accurate, complete, and traceable to the tested products. Any additional nonconformances shall be processed in accordance with paragraph 8.12.

8.14.5 Inspection and Test Records (Component Level to End-Item)

8.14.5.1 General Requirements--The contractor shall prepare and maintain records, including logs, of all inspections and tests to show that all operations have been performed, that objectives have been met, and that end-items have been fully verified.

8.14.5.2 Scope--Records shall cover each component, subsystem, and system. As the hardware is integrated, records of lower-level assembly products shall be combined into those for the end-item as a

means of compiling a continuous chronological history of identified hardware, fabrication, assembly, inspection, and tests, as well as other actions or data important to a complete assurance record.

8.15 CONFIGURATION VERIFICATION

Assurance personnel are required to verify that the as-built product complies with the applicable as-designed configuration listing and that it is in accordance with approved configuration documents as required by the Configuration Management Plan and with paragraphs 8.2, 8.3, and 9.1.

8.16 METROLOGY

8.16.1 General Requirements

The contractor shall establish and comply with a documented metrology system for ensuring that measurement standards and equipment are selected and controlled to the degree necessary to meet drawing requirements. The system shall be in accordance with the provisions of MIL-STD-45662 (Appendix A).
Tools, gauges, jigs, and fixtures for measuring dimensions, contours, or locations that affect quality characteristics shall be checked for calibration status before use. Checks and recalibrations shall be made at predetermined intervals to ensure continued accuracy.

8.16.2 Instruments Used for Measuring

Tools, gages, jigs, and fixtures for measuring dimentions, contours, or locations that affect quality characteristics shall be checked for calibration statue before use. Checks and recalibrations shall be made at predetermined intervals to ensure continued accuracy.

8.16.3 Product Measurement Processes

Random and systematic errors in any article or material measurement process shall not exceed 10 percent of the tolerance or material characteristics being measured. When state of the art or other considerations make this provision impossible or impracticable, the contractor shall maintain a list of those exceptions, and they shall be available for review upon request.

8.16.4 Calibration Measurement Processes

Random and systematic errors in any calibration measurement process shall not exceed 25 percent of the tolerance of the parameter being measured. When state of the art or other considerations make this provision impossible or impracticable, the contractor shall maintain a list of those exceptions, and they shall be available for review upon request.

8.17 STAMP CONTROL SYSTEM

The contractor shall establish and maintain a documented stamp control system that provides the following:

a. Stamps, decals, seals, and paints shall comply with the criteria of paragraph 6.2.4 and shall show that products have undergone source and receiving inspection, in-process fabrication and inspection, end-item fabrication, inspection and storage, and shipment.

b. Stamps shall be traceable to the individual responsible for their use, and records shall be maintained to identify the individual. Fabrication (manufacturing) and inspection stamps shall be of different designs.

c. Stamps shall be applied to records to indicate the fabrication or inspection status of the products.

8.18 SAMPLING PLANS

Sampling plans may be used when inspections or tests are destructive or when data, inherent characteristics, or noncritical application of a product permits a reduction in inspection or testing. Such plans shall not jeopardize quality, reliability, or design intent. Sampling plans shall be identified in the applicable inspection procedures.

8.19 TRAINING AND CERTIFICATION FOR MANUFACTURING AND INSPECTION PERSONNEL

8.19.1 Training

The contractor shall use trained personnel for implementing the performance assurance program and processes control. Training programs shall be developed, documented, implemented, and maintained for personnel who may have an effect on reliability and quality.

8.19.2 Certification and Recertification of Personnel

a. Certification--Contractor personnel who control selected processes or perform selected operations such as soldering, module welding, potting, encapsulation, and radiography shall be certified on the basis of evidence of competence that includes training and testing.

b. Recertification--Contractor personnel shall be recertified if they fail to perform satisfactorily in producing products or services, if changes occur in techniques or required skills, or if their work experience as established for the process or operation is interrupted. Recertification shall require retesting of the individual to demonstrate proficiency. Persons who fail the retest shall not perform the tasks until they receive additional training and proficiency has been demonstrated.

8.19.3 Records

Records shall be maintained of the training, testing, certification, and recertification status of personnel.

8.20 HANDLING, STORAGE, PRESERVATION, MARKING, LABELING, PACKAGING, PACKING, AND SHIPPING

The contractor shall write and implement procedures for the handling, storage, preservation, marking, labeling, packaging, packing, and shipping of all products.

These procedures shall be submitted in accordance with Appendix C and shall implement the requirements of NHB 6000.1 (Appendix A) and the following paragraphs.

8.20.1 Handling

The protection of products during the life of the program shall be achieved through the use of handling equipment and techniques that have been certified before use. Evidence of initial and periodic proof-testing of handling equipment shall be maintained.

8.20.2 Preservation, Marking, Labeling, Packaging, and Packing

Products shall be stored, preserved, marked, labeled, packaged, and packed to prevent deterioration, contamination, or damage during all phases of the program. Stored and stocked items shall be controlled in accordance with documented procedures.

8.20.3 Shipping

Prior to shipping, the contractor shall ensure that:

a. Fabrication, inspection, and test operations have been completed and accepted.

b. All products are identified and marked in accordance with requirements.

c. The accompanying documentation (contractor's shipping and property accountable form) has been reviewed for completeness, identification, and quality approvals.

d. Evidence exists that preservation and packaging requirements have been complied with.

e. Packaging is adequate to ensure safe arrival and ready identification at their destination.

f. The loading and transporting methods are in compliance with those designated in the shipping documents.

g. Integrity seals have been placed on shipping containers.

h. In the event of unscheduled removal of a product from its container, the extent of reinspection and retest shall be as authorized by POES or its representative.

i. Special handling instructions for receiving activities are provided where appropriate.

The contractor's quality assurance organization shall verify prior to shipment that the above requirements have been met. QA shall sign off appropriate shipping documents to provide evidence of this verification.

8.21 GOVERNMENT PROPERTY CONTROL

8.21.1 Contractor's Responsibility

In accordance with the provisions of the contract, the contractor shall be responsible for and shall account for all property supplied by the Government, including government property that may be in the possession or control of a supplier. The contractor's responsibility shall include, but not be limited to, the following:

a. Upon receipt, examination of products to detect damage that may have occurred in transit.

b. Inspection for quantity, completeness, proper type, size, and grade as specified in the shipping documents.

c. Provision for the protection, maintenance, calibration, periodic inspection, segregation, and controls necessary for preventing damage or deterioration during handling, storage, installation, or shipment.

d. Maintenance of records that include:

(1) Identification of the property

(2) Location of the property

(3) Dates, types, and results of contractor inspections, tests, and other significant events

e. Any functional tests on the product that are directed by the POES Project Office.

8.21.2 Unsuitable Government Property

The property shall be processed in accordance with government procedures and paragraph 8.13. The property shall not be disposi-tioned, repaired, reworked, replaced, or in any way modified unless such action is authorized by the contract or by the contracting officer.

8.22 GOVERNMENT ACCEPTANCE

Before acceptance by POES, contractor quality assurance personnel shall ensure that deliverable contract end-items, including the Acceptance Data Package, are in accordance with contract requirements. A copy of the data package shall be submitted to POES in accordance with Appendix C, and a copy shall accompany each end item.

9.0 CONTAMINATION CONTROL REQUIREMENTS

9.1 APPLICABILITY AND DEFINITIONS

This meeting provides requirements for meeting the contamination control needs of a project; it is applicable to the instrument and its elements. Contaminants are defined as those materials, either at a molecular or a particular level, whose presence degrades mission performance.

9.2 CONTAMINATION ALLOWANCE

As a basis for contamination control activities, the contractor shall establish a contamination allowance for performance degradation of contamination-sensitive hardware such that, even in the degraded state, the hardware will meet its mission objectives. The allowance and the rationale for its selection shall be delineated in the CCP and shall serve as a basis for the measures to be taken to control contamination.

9.3 CONTAMINATION CONTROL

The contractor shall delineate in the CCP the measure to be taken for controlling contamination so that the contamination allowance established in paragraph 9.2.1 is not exceeded and for the purpose of verifying that the performance degradation limits established under paragraph 9.2.1 have not been exceeded. The measures shall include the implementing and controlling documentation that describes the methods for measuring and maintaining the levels of cleanliness required during the various phases of the hardware lifetime. The documentation shall include criteria for defining out-of-control conditions and ways of dealing with them. The CCP shall contain analyses that show how the controls will result in meeting the contamination allowance and the verifications as are necessary for demonstrating that the performance degradation limits have not been exceeded.

The CCP shall include, in a separate section, those contamination control to be exercised in preparing the thermal-vacuum chamber and the necessary fixtures and stimuli for system level tests. It shall also include those operational procedures that will be followed to minimize the contamination hazard, from pumpdown through return to ambient conditions. Test phases that represent contamination hazards and the approaches to be taken to minimize these hazards shall be addressed. Pretest measurements, monitoring methods to be used during the test, and post-test measurements for verifying that contamination criteria have not been exceeded shall be discussed. Contingency plans dealing with the possibility that contamination criteria are exceeded shall be included.

To the extent necessary to meet mission requirements; major wiring harnesses and thermal blankets shall be baked-out. Because they can be a source of contamination, special consideration shall be given to material and equipment used in cleaning, handling, and packaging flight hardware.

APPENDIX A

APPLICABLE DOCUMENTS

APPLICABLE DOCUMENTS

Paragraph No.	Document No.	Title	Available From
		Section 1	
1.1	NHB 5300.4 (lA)	Reliability Program Provisions for Aeronautical and Space System Contractors	See Note
1.1	NHB 5300.4 (lB)	Quality Program Provisions for Aeronautical and Space System Contractors	See Note
2.4	S-311-98A	Guidelines for Conducting a Packaging Review	POES Project Office
		Section 4	
4.1	E&WR 127-1	Western Space and Missile Center Safety Requirements, Range Safety Regulations	POES Project Office
4.1	MIL-STD-1574A	System Safety Program for Space and Missile System	See Note
		Section 5	
5.2.2	311-INST-001	Parts Selection and Processing	POES Project Office
5.2.6	S-311M-70	GSFC Specification--Construction Analysis of Electronic Parts	POES Project Office
5.3	GSFC PAPL	Program Approved Parts List	POES Project Office
5.3	GSFC PIL	Parts Identification List	POES Project Office

Paragraph No.	Document No.	Title	Available From
		Section 6	
6.2.1	None	GSFC Materials Tips for Spacecraft Applications	POES Project Office
6.2.4	ASTM E595-77	Standard Test Method for Total Mass Loss and Collected Volatile Condensable Material from Outgas in a Vacuum Environment	See Note 8
		Section 7	
7.3.2	GSFC (PPL)	GSFC Preferred Parts List	POES Project Office
7.3.2	MIL-STD-975	NASA Standard EEE Parts List	POES Project Office
		Section 8	
8.4.8	MSFC-STD-655	Weld Filler Metal Fastener	See Note 7
8.4.9	S-313-100	Fastener Integrity Requirements	POES Project Office
8.9.3	NHB 5300.4 (3A-2)	Requirements for Soldered Electrical Connections	See Note 4
8.9.3	NAS 5300.4 (3G-1)	Requirements for Interconnecting Cables, Harness, and Wiring	See Note 4
8.9.3	NHB 5300.4 (3H)	Requirements for Crimping and Wire Wrap	See Note 4
8.9.3 8.14.3.4	MIL-STD-275/ANSI-IPC-D-275	Printed Wiring for Electronic Equipment	See Note 3

Paragraph No.	Document No.	Title	Available From
8.9.3 8.14.3.4	S-312-P-003	Procurement Spec Rigid Printed Boards for Space Applications and Other High Reliability Uses	See Note 3
8.9.3	NAS 5300.4 (3J-1)	Requirements for Conformal Coating and Staking of Printed-Wiring Boards and Electronic Assemblies	See Note 4
8.9.3	NAS 5300.4 (3M)	Workmanship Requirements for Surface Mount Technology	See Note 4
8.16.1	MIL-STD-45662 Notice 3	Calibration System Requirements	See Note 5
8.20	NHB 6000.1C	Requirements for Packaging, Handling, and Transportation	See Note 4

NOTES (Sources):

1. NASA/Lyndon B. Johnson Space Center, Publication Control Office, Houston, TX 77058.

2. NASA/Scientific and Technical Information Facility, P. O. Box 87S7, BWI Airport, MD 21240.

3. NASA/John F. Kennedy Space Center, Publication Control Office, Kennedy Space Center, FL 32899.

4. Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402.

5. Department of the Navy, Naval Publications and Forms Center, 58Ol Tabor Avenue, Philadelphia, P-A 19120.

6. National Technical Information Service, Springfield, VA 22161.

7. NASA/George C. Marshall Space Flight Center, Marshall Documentation, Huntsville, AL 3S812.

8. American Society for Testing Materials, 1916 Race Street, Philadelphia, PA 19103.

*NTIS (Note 6) Accession Numbers: Documents can be ordered individually from NTIS by these numbers.

APPENDIX B

GLOSSARY

GLOSSARY

Acceptance Tests--The process that demonstrates that hardware is acceptable for flight. It also serves as a quality control screen for detecting deficiencies and normally for providing the basis for delivery of an item under terms of a contract.

Assembly--A functional subdivision of a component, consisting of parts or subassemblies that perform functions necessary for the operation of the component as a whole e.g.,., a power amplifier and gyroscope).

Audit--A review of the contractor's or subcontractor's documentation or hardware to verify that it complied with project requirements.

Box, Electronic--See --Component.--

Collected Volatile Condensable Material (CVCM)--The quantity of outgassed matter from a test specimen that condenses on a collector maintained at a specific constant temperature for a specified time. CVCM i8 expressed a~ a percentage of the initial specimen mass.

Component--A functional subdivision of a subsystem and generally a self-contained combination of items performing a function necessary for the subsystem's operation (e.g., transmitter, gyro package, actuator, motor, and battery).

Configuration--The functional and physical characteristics of parts, assemblies, equipment of systems, or any combination of these that are capable of fulfilling the fit, form, and functional requirements defined by performance specifications and engineering drawings.

Configuration Control--The systematic evaluation, coordination, and formal approval/disapproval of proposed changes and implementation of all approved changes to the design and production of an item, the configuration of which has been formally approved by the contractor, the purchaser, or both.

Configuration Management--The systematic control and evaluation of all changes to baseline documentation and subsequent changes to that documentation that define the original scope of effort to be accomplished (contract and reference documentation) and the systematic control, identification, status accounting, and verification of all configuration items.

Derating--The reduction of the rating of a device to improve reliability or to permit operation at high ambient temperatures.

Design Specification--Generic designation for a specification that describes functional and physical requirements for an article, usually at the component level or higher levels of assembly. In its initial form, the design specification is a statement of functional requirements with only general coverage of physical and test requirements. The design specification evolves through the project life cycle to reflect progressive refinements in performance, design, configuration, and test requirements. In many projects, the end-item specifications serve all the purposes of design specification for the contract end-items. Design specifications provide the basis for technical and engineering management control.

Designated Representative--An individual (Such as a NASA plant representative), firm (such as assessment contractor), Department of Defense (DOD) plant representative, or other government representative designated and authorized by NASA to perform a specific function. As related to the contractor's effort, this function may include evaluation, assessment, design review participation, and review/approval of certain documents or actions.

Destructive Physical Analysis (DPA) --An internal destructive examination of a finished part or device to assess design, workmanship, assembly, and any other processing associated with fabrication of the part.

Discrepancy--See -Nonconformance.-

Electromagnetic Compatibility--The condition that prevails when various electronic devices are performing their functions according to design in a common electromagnetic environment.

Electromagnetic Interference (EMI--Electromagnetic energy that interrupts, obstructs, or otherwise degrades or limits the effective performance of electrical equipment.

Electromagnetic Susceptibility--Undesired response by a component, subsystem, or System to conducted or radiated electromagnetic emission.

End-to-End Tests--Tests performed on the integrated ground and flight system, including all elements of the instruments, its control, communications, and data processing to demonstrate that the entire System is operating in a manner that will fulfill all mission requirements and objectives.

Failure--See --Nonconformance.--

Failure Modes, Effects, and Criticality Analysis (FMECA)--Study of a system and working interrelationships of its elements to determine ways in which failures can occur (failure modes), the effects of each potential failure on the system element in which

it occurs

and on other system elements, and the probable overall consequences (criticality) of each failure mode on the success of the system's mission. Criticality's are usually assigned by categories, each category being defined in terms of a specified degree of loss of mission objectives or degradation of personnel safety.

Functional Tests--The operation of a unit in accordance with a defined operational procedure to determine whether performance is within the specified requirements.

Hardware--As used in this document, there are two major categories of hardware as follows:

1. Prototype Hardware--Hardware of a new design; it is subject to a design qualification test program; it is not intended for flight.

2. Flight Hardware--Hardware to be used operationally in space. It includes the following subsets:

a. Protofliqht Hardware--Flight hardware of a new design; it is subject to a design qualification test program.

b. Follow-on Hardware--Flight hardware built in accordance with a design that has been qualified either as prototype or as protoflight hardware; follow-on hardware is subject to a flight acceptance test program.

c. Spare Hardware--Hardware whose design has been proven in a design qualification test program; it is subject to a flight acceptance test program and is used to replace flight hardware that is no longer acceptable for flight.

d. Reflight Hardware--Flight hardware that has been used operationally in space and is to be reused in the same way; the verification program to which it is subject depends upon its past performance, current status, and the upcoming mission.

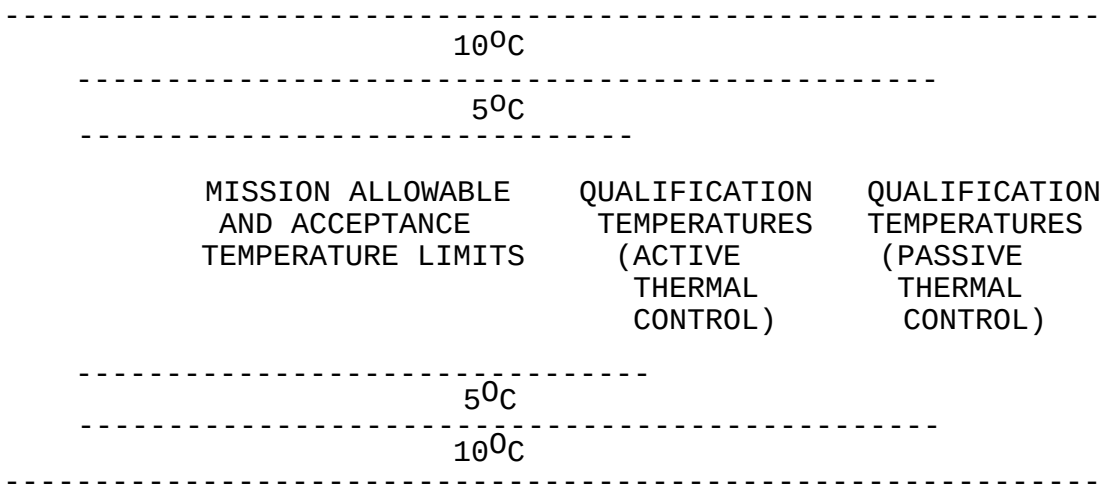
Inspection--The process of measuring, examining, gauging, or otherwise comparing an article or service with specified requirements.

Instrument--A subsystem consisting of sensors and associated hardware for making measurements or observations in space.

Marqin--The amount by which hardware capability exceeds requirements.

Mission Allowable Temperatures--The mission allowable temperature limits shall encompass those temperatures experienced during the mission and during system-level thermal balance testing.

The relationship between mission allowable, acceptance, and qualification temperatures is as follows:



Monitor--To keep track of the progress of a performance assurance activity; the monitor need not be present at the scene during the entire course of the activity, but he will review resulting data or other associated documentation. (See Witness)

Nonconformance--A condition of any hardware, software, material, or service in which one or more characteristics do not conform to requirements. As applied in quality assurance, nonconformances fall into two categories:

1. Discrepancy--A discrepancy is a departure from specification detected during inspection or process control testing, etc., while the hardware or software is not functioning or operating.

2. Failure--A failure is a departure from specification that is discovered in the functioning ~r operation of the hardware or software.

Part--A hardware element that is not normally subject to further subdivision or disassembly without destruction of designed use.

Performance Verification--Determining by test, analysis, or a comdination of the two that the instrument can operate as intended in a particular mi~sion; this instrument verification includes en~uring that the design of the instrument or element has been qualified and that the particular item has been accepted as true to the design and ready for flight operations.

Prototype Hardware--See-Hardware.

Qualification--The process of demonstrating that a given design and manufacturing approach will produce hardware that will meet all performance specification when subjected to defined conditions more severe than those expected to occur during its intended use.

Redundancy (of desiqn--The use of more than one independent means of accomplishing a given function.

Repair--The article is to be modified by established (customer approved when required) standard repairs or specific repair instructions that are designed to make the article suitable for use but that will result in a departure from the original specification.

Rework--Return for completion of operation~ (complete to drawing). The article is to be reprocessed to conform to the original specifications or drawings.

Similarity, Verification By--A procedure of comparing an item to a similar one that has been verified. Configuration, test data, application, and environment should be evaluated. It should be determined that design differences are insignificant, that environmental stress will not be greater in the new application, and that manufacturer and manufacturing methods are the same.

Single-Point Failure--A single element of hardware, the failure of which should result in loss of mis~ion objectives or hardware as defined for the specific application or project for which a single-point failure analysis is performed.

Spacecraft--An integrated assemblage of subsystems designed to perform a specific mission in space.

Subassembly--A subdivision of an assemhly (e.g., wire harness and loaded printed-circuit boards).

Subsystem--A functional subdivision of an instrument consisting of two or more components (e.g., attitude control, electrical power, and communications subsystems).

Thermal Balance Test--A test conducted to verify the adequacy of the thermal design and the capability of the thermal control system to maintain thermal conditions within established mission limits.

Total Mass Loss (TML)--Total mass of material outgassed from a specimen that is maintained at a specified constant temperature and operating pressure for a specified time. TML is expressed as a percentage of the initial specimen mass.

Vibroacoustics--An environment induced by high-intensity acoustic noise associated with various segments of the flight profile; it manifests itself throughout the instrument in the form of directly transmitted acoustic excitation and as structure-borne random vibration excitation.

Witness--A personal on-the-scene observation of a performance assurance activity with the purpose of verifying compliance with project requirements (See Monitor.)

APPENDIX C

DELIVERABLE DATA AND GSFC RESPONSE

DELIVERABLE DATA AND GSFC RESPONSE

l. DEFINITION

For purposes of this attachment, the following definitions apply to this document.

1.1 APPROVAL

Documents in this category require receipt by the POES Project within the time specified and written approval prior to contractor implementation. Requirements for resubmission shall be as specified in letter(s) of disapproval. The POES Project shall act on items requiring approval within 14 days of receipt of the item.

1.2 REVIEW

Documents in this category must be received by the POES Project within the time period specified, and will be subject to evaluation. These documents may be implemented upon issuance unless otherwise noted. however, when an evaluation reveals inadequacies in a document, the contractor shall correct the document as required.

1.3 INFORMATION

Documents in this category will be-used by the POES Project to determine current program status and progress and for future planning requirements.

1.4 ACA

After Contract Award.

2. MAILING AND DISTRIBUTION

Copies

1	NOAA Liaison Office	GSFC Code 480
l	POES Instrument Manager	GSFC Code 480
1	Technical Officer	GSFC Code 480
Balance	Flight Assurance Manager	GSFC Code 480

3. DOCUMENT TO BE SUBMITTED

The following documentation shall be provided in accordance with the specified reference.

DELIVERABLE DATA AND GSFC RESPONSE

Item	Document	Ref. Para. No	Delivery Date	QTY	Action Required
1.	POES Flight Assurance Review Data Package	2.2	2 weeks before review meeting	20	I
2.	Verification Plan	3.2.1			
	a. Baseline		With contract	5	A
	b. Update		At time of POES Flight Assurance CDR	5	A
3.	Verification Reports	3.2.2	30 days after completion of activity	5	I
4.	Operations Hazard Analyses	4.3.2	30 days before an activity or use of a facility	5	I
5.	Safety Data Package	4.6	At time of POES Flight Assurance CDR	5	A
6.	Contractor DPA Procedures and Requirements	5.2.6	As generated	5	R
7.	PAPL & PIL	5.3		5	I
8.	Data on cured, out-of-dated materials	6.1.6	30 days before use of materials	1	A
9.	Performance Assurance Status Report	1.5	Monthly, as part of STR-108 (AT) Monthly Progress Report	-	I
10.	Data on Nonconventional application of Materials	6.3.a	30 days before use of material	5	A
11.	Engineering Drawings	6.3.b	Upon request	5	I

Item	Document	Ref. Para. No.	Delivery Date	QTY	Action Required]
12.	Failure Mode, Effects and Criticality Analyses, and Critical Parts List	7.3.1		5	R
	a. Final		30 days before POES Flight Assurance CDR	5	R
13.	Parts Stress Analyses:	7.3.2			
	a. Final		30 days before POES Flight Assurance CDR	5	R
	b. Update		With class 1	5	R
14.	Trend Analyses	7.3.4			
	a. List of parameters to be monitored		At time of POES Flight Assurance CDR	5	I
	b. Trend analysis		As generated	5	I
15.	Limited Life List	7.4			
	a. Final		30 days before POES Flight Assurance CDR	5	R
	b. Updates		As changes are made; between POES Flight Assurance and delivery	5	R
16.	Fabrication and Assembly Flow Plan:	8.10.1	30 days before POES Flight Assure CDR	5	R
17.	Electrostatic Discharge Control Plan	8.11	30 days before POES Flight Assurance CDR	5	A

Item	Document	Ref. para. No.	Delivery Date	QTY	Action Required
18.	Request for Repair/ Use As-Is	8.12.1.3.c	As generated	5	A
19.	Standard Repair Procedures	8.12.1.3.c.1	As generated	5	A
20.	Malfunction/Failure Reporting:	8.12.2.1	As generated	5	A
	a. Notification		Orally, within 24 hours		I
	b. Written Notification(MR Form)		Within 3 working days	1	I
	c. Failure analysis proposed corrective action		Orally		I
	d. Malfunction/Failure Report Close-out	8.12.2.2	Completion of required Actions	1	A
21.	Alerts	8.13			
	a. Notification		As generated	5	I
	b.Response to Alerts	8.13	10 working days after receipt of notification	5	R
22.	Procedures for Product Handling:	8.20			
	a. Preliminary		30 days before POES Flight Assurance CDR	5	I
	b. Final		30 days before use	5	A
23.	Acceptance Data Package for each end-item comprising:	8.22	At time of delivery of each end-item	5	R
	a. As-built configuration list in accor-				

dance with paragraph
8.16

Item	Document	Ref. para. No.	Delivery Date	QTY	Acti Requir
	b. Lists of arts/devices used in the hardware, prepared in ccordance with paragraph 5.4				
	c. List of materials and processes that were used in the hardware				
	d. Test Log Book, includ- in total operating time and cycle records				
	e. List of open items with reasons for items being open				
	f. Safety compliance	Data Package			
	g. Listing and status of all identified life-limited items				
	h. Critical parameters trend data				
	i. Results of the sive performance test	final comprehen-			
32.	Contamination Control Plan:	9.3			
	a. Update		At time of POES Flight Assurance CDR	5	A